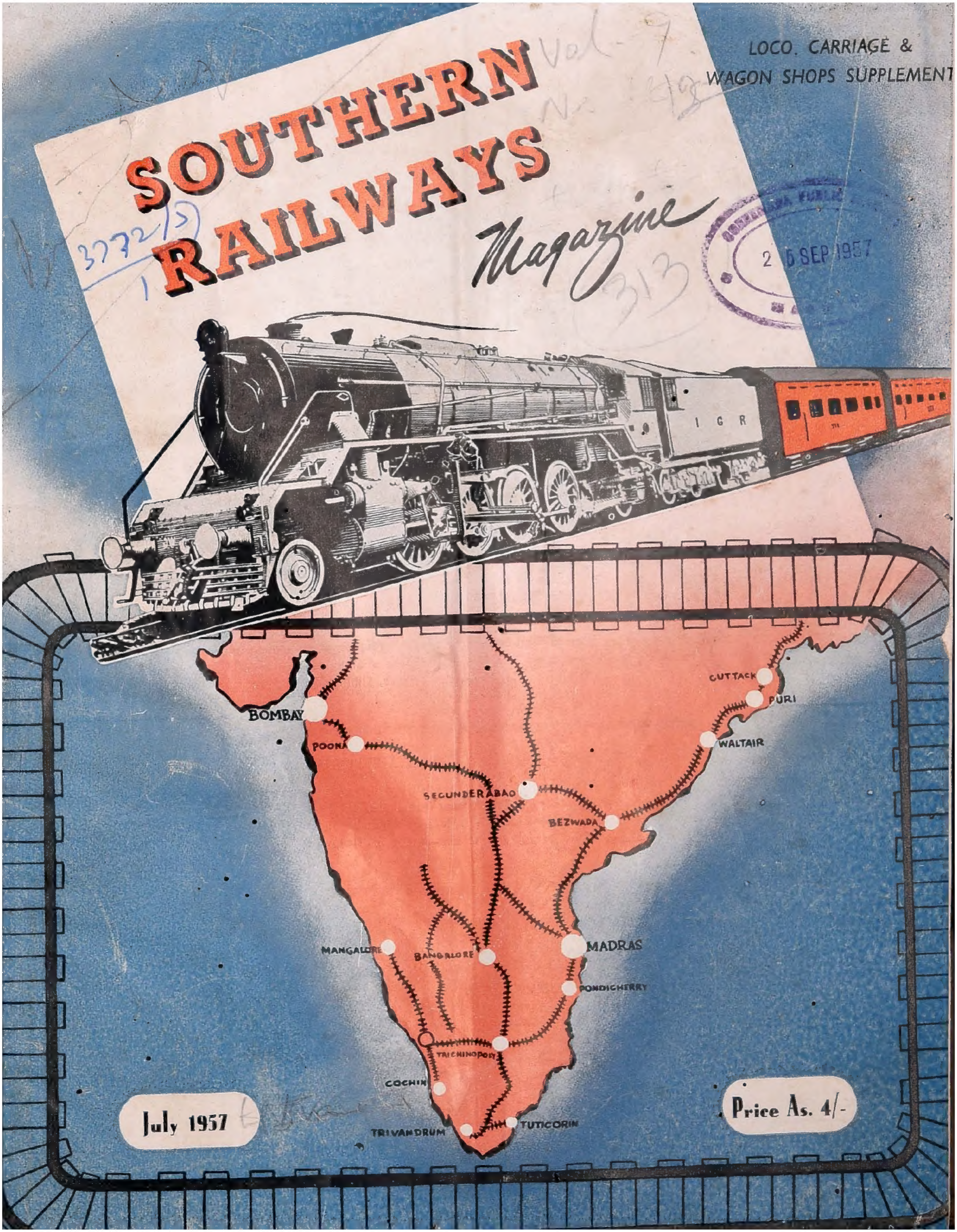
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CONTENTS

Editorial Notice

The Editor invites contributions to the Magazine on a variety of topics—short stories, technical features written in simple English understandable to the laymen, Aspects of Railway Working, places of tourist interest, News from home line, activities on Railway Institutes etc. All copy should be brief and typed as far as possible.

Photographs illustrating social functions, sports events, scenic spots etc. are also invited. All contributions should reach the Editor not later than 5th of each month. Rejected Mss. will be returned provided sufficient stamps for postage are enclosed. No responsibility will be borne for copy lost in transit.

Views expressed in this Magazine should not be taken as having official authority.

All correspondence should be addressed to the Editor, "Southern Railways Magazine", Post Box No. 17, Tanjore, (South India).

Discipline and Production in Railway Workshops

APART from well trained personnel (workmen as well as Supervisors) and good and uptodate machines in sufficient number, one of the most important factors which make for greater production in any workshop is Discipline.

Discipline does not consist of blind obedience to orders, but an attitude of mind which enforces regular and systematic working without loss of precious production hours irrespective of the quality of supervision.

Judging production with this yard stick, it must be admitted that work in Railway Workshops has deteriorated and the out turn of pounds per man hour has been gradually diminishing until today it is at a pretty low ebb.

Prior to the Second World War and in the early nineteen-thirties the Railway Workshops were predominantly controlled by Englishmen in the Superior Services and by Indians in the subordinate supervisory services and at that time discipline stood at a high level.

The Englishmen of those days belonged to a disciplined nation and discipline was a part and parcel of their life and they saw to it that it was observed by all with whom they came into contact.

Punctuality was a habit in which Englishmen generally excelled. When an Englishman made an appointment with anybody, he was usually present a few minutes early, but very seldom even a few minutes late. What punctuality he observed himself he demanded it from others and definitely enforced it on his subordinates.

If a meeting was fixed for a particular time, it was customary for all members attending the meeting to assemble outside the meeting hall a few minutes before time and walk in on the stroke of time.

If trains were scheduled to arrive at a particular station at a particular hour they saw to it that they were not even a minute late and also after their due halt they left the station on the stroke of time. Failure to achieve the time schedules was frowned upon on the first occasion, but a repetition brought on severe disciplinary action including reduction in grade on drivers, guards and others concerned.

If orders were given and if they were not clear, this had to be disclosed by the subordinates at that time and then the matter was explained clearly. But once the matter was supposed to be understood the subordinates were expected to carry out the instructions to the letter in detail and no explanation for failure to carry them out was accepted. The normal rejoinder which a subordinate received if work was delayed sometime was " I want work and I am not prepared to accept excuses ".

In those days, Works Manager and his Assistants and the Senior Supervisors of the Foremen Class in the Workshops had a considerable amount of power, which is an essential feature of discipline. For a mistake or inability to carry out orders or dereliction of duty a workman or Supervisor was fined a fairly heavy amount or was reduced in status or sent home for a period on loss of pay. If the action or omission was serious, he was removed from service and in the interest of discipline and at times dismissed and the orders once passed were upheld by superior authority unless they were palpably unjust or unfair.

Englishmen, as a rule, had a very high sense of what is known as 'fairplay' and dispensed justice without fear or favour and it was an extremely rare occurrence if at any time the orders once given were ever reversed.

The Indian Workshop Supervisors with grades of Foremen and Senior Chargemen taking the queue from the English Officers and Managers extracted work from their workmen, especially if these orders came from any high authority. Further, as these foremen themselves were capable of working with their hands, having risen to their present position from the lowest rung of the ladder of workmen, when it came to emergency or a time limit was fixed for a job, they often forgot their higher status as Supervisors took off their coats, rolled up their sleeves and worked with their hands side by side with their workmen day and night until the job was completed within the limited time.

The Supervisors, because they knew the work of the branch of which they held charge, were respected by their workmen, who learnt a considerable amount of work and the various trade secrets from them.

There were, however, black sheep in every fold and Supervisors were no exception. Some of them undoubtedly accepted illegal gratification from their workmen or they bullied their workmen because they were in the

position of Supervisors or they were harsh to the men even to the extent of striking them when the occasion called for it, but on the whole inspite of all their defects they did maintain a very high sense of discipline and extracted a fair day's work for a fair day's pay from the workmen under their charge.

What is the picture today? Punctuality is very seldom observed. If a man comes to his appointment 15 minutes to half an hour late and makes the necessary excuse that the train was late or the buses were crowded and he could not get room etc., such an explanation is accepted without a question. It never strikes the man concerned to start from his home or the starting point half an hour earlier to offset any such obstacles indicated above. The saddest part of it all is that he gets away easily with his excuses and so keeps on propagating unpunctuality on various occasions.

At important meetings, sometimes, the convener of the meeting or the Chairman himself is late and the members invited, should they have come in time, have to cool their heels for considerable period before the meeting starts, with the result that on future occasions when such meetings are called for they deliberately come late because of the example set.

Train services are habitually late these days and the arrival of a train at a station at the scheduled time according to the Time Table is looked as a great achievement. When signals are lowered and the Guard blows his whistle and waves his green flag very frequently nothing happens. The Driver or the Fireman or the Khalasi probably hold up the train in order to meet their requirements in the nearby bazar or elsewhere.

It has now become a habit in most Railway Workshops for the workmen to arrive at the gates of the Workshops when the second buzz is blowing and they still have all way to walk to their places of work, which often take them ten to fifteen minutes and by the time they remove their clothes and get into their working clothes they waste anything from half an hour to three quarter of an hour before starting their work. Similarly, they just wash and change their clothes ready to go at least half an hour before the actual blowing of the buzz indicating the stoppage of work. This happens twice a day and as a result anything from 2 to 2½ hours are wasted out of the 8 hours work per day. This has now come to be looked upon as normal and if 6 hours work can be obtained from the workmen out of 8 hours, the management is quite complacent of having fulfilled its demand.

Orders given are very seldom carried out either completely or in time and it is not unusual to find that for some reason or other the job has not even been started on the day it is supposed to be completed.

Supervisors have very little power over the men because they know the limitations of the disciplinary powers that could be exercised by supervision, particularly when they have rights of appeal which can in most cases have the Supervisor's orders reversed as and when required. Further, the Supervisor who tries to enforce discipline is sometimes assaulted outside the works and has no redress because the occurrence occurred outside the workshop premises. In the circumstances, Supervisors are diffident to enforce discipline.

The service rules regarding discipline and appeal are so much in favour of workman and there are so many loop holes that in 9 cases out of 10 he has an opportunity of being reinstated in service from which he has been removed.

With the dice so much loaded against management and supervision with poorer quality of work and so much loss of time, what is the use of talking about production and increase in production—it just cannot be achieved under present conditions.

Discipline first and discipline last is the only answer which will solve this great malaise under which our Railway Workshops are working today.

Improvement in output can only be expected if the power is put back into the hands of management and supervision where it rightly belongs.

There must be simplification in the labour rules of discipline and appeal and there must be support for every just action taken by the Supervisor against his men so that the men are made to realise that they just cannot get round the disciplinary action by appealing to rules. If all this is done and greater responsibility put on the shoulders of management and supervision and implicit trust is imposed on them at each rung of the ladder of supervision, then and there only can we expect greater production in pounds per man hour in Railway Workshops.

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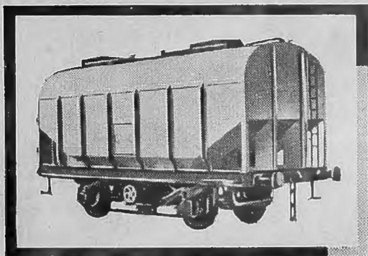

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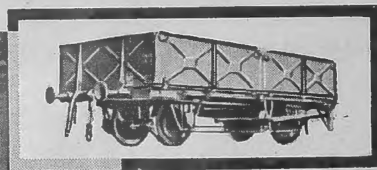

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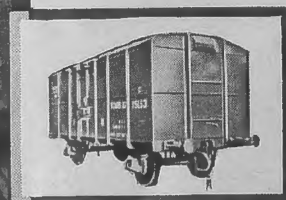
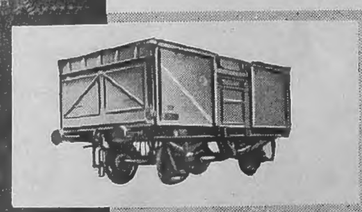


Broad gauge covered Wagon type C.R. as used by Indian Railways.



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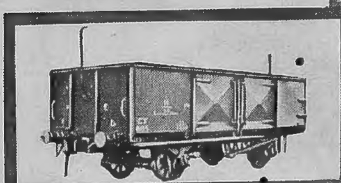
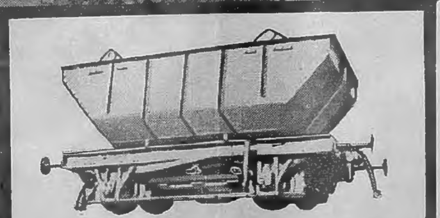


22-ton G.Y. type Wagon as used by Victoria Government Railways, Australia.



V. J. M. Hopper type Wagon with Drop Bottom Door as used by Queensland Government Railways, Australia.

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THE AUTOGENOUS RAIL WELDING

By An Engineering Correspondent

INTRODUCTION

IN the manufacture of rails we employ steel of a high carbon content, having also silicomanganese alloys also. The binary rails are an exception, their front zone containing in addition, chromium as an alloying constituent. The following table offers a survey on the tensile strength, the standard analyses and the wearing quality of rails.

COMPOSITION OF THE WELDINGS

kind of steel	*tensile strength kg./sqmm.*	*C*	*Si*	*Mn*	*P max. %*	*S Max.%*	*Cr %*	*wear resistance in comparison to standard quality*
				standard quality				
Th	70–85	0,35–0,55	0,15–0,35	0,6–1,0	0,08–	0,06–	—	1
SM	70–85	0,40–0,60	0,15–0,35	0,6–1,0	0,06	0,06	—	1

kind of steel	*tensile strength kg./sqmm.*	*C*	*Si*	*Mn*	*P max. %*	*S Max.%*	*Cr %*	*wear resistance in comparison to standard quality*
				medium-wear resistant rails				
SM	80-95	0,55-0,70	0,15-0,35	0,6-1,0	0,06	0,06	—	1,2-1,4
				wear resistant, self-hardening one-material rails				
SM		0,60-0,75	0-15-0,35	0,7-1,0	0,05	0,05	—	2,0-4,0
SM	90-110	0,50-0,65	0-15-0,35	1,4-1,7	0,05	0,05	—	2,0-4,0
E		0,45-0,60	0-10-0,30	1,7-2,0	0,03	0,03	—	2,0-4,0
				wear resistant rails hardened in a special process: head-hardened rails				
Th	of a Brinell	0,40-0,50	0,15-0,35	0,6-1,0	0,07	0,05	—	1,6-4,0
Th	hardness of	0,30-0,40	0,5 -0,8	0,6-0,9	0,07	0,05	—	
SM	125-150	0,30-0,45	0,5 -1,0	0,6-1,2	0,05	0,05	—	
				binary rails a) head zone				
SM —	110-130	0,60-0,75	0,15-0,35	0,6-0,9	0,5	0,5	0,7-1,2	3,0-4,5
E —		0,60-0,75	0,15-0,35	0,6-0,9	0,3	0,5	0,7-1,2	
				b) web- and base zone				
SM	50-65	0,20-0,35	0,15-0,35	0,3-0,6	0,06	0,06	—	—

Th – Thomas steel. SM – Siemens Martin steel. E – Electro steel

Rails of guaranteed quality are mainly employed. They can be welded well by autogenous welding, provided that prescribed and tested welding rods are used.

Rails of medium wear-resistant quality as well as wear-resistant, self-hardening, single-component rails; are to be welded according to the above mentioned welding process and attention must be paid to special safety measures, that will be discussed in detail hereafter.

Top-hardened rails can certainly be autogenously welded, but this is inappropriate, since by the repeated heat-treatment a softening will take place by which, after a short period of use, road holes will be formed at the welded joints. A hardening following the welding, fails also to be effective, since at the beginning and at the end backlashes will result, that will entail the same shortcomings. These considerations are of course also valid for all other welding processes applied to rails.

The autogenous welding of binary rails is effected in the same way as that of standard quality rails. There are no difficulties as the base and the web of these rails are made of standard rail steel.

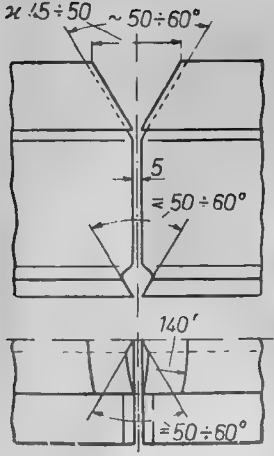
RAIL JOINT WELDING

As is well-known, rails are united by fish plates; yet this joint is imperfect, since both requirements, v.i.z. free movement of the rail end and entirely closed shutting between rail and fish plate, cannot be simultaneously met because of the wear between the two parts. It is therefore obvious, that we took advantage of the progress in welding technique for the perfection of rail joints, in uniting the rail ends by welding, thus limiting or eliminating these spots, that constitute considerable part of the expenses involved in rail maintenance. The welding of rails has reached a level, as far as rails of standard quality are concerned, that does no longer justify objections in order to avoid welding because of technological conditions of the welded joint.

Continuous welding of rails meets other objections nowadays, but a solution of the still outstanding questions may be expected by scientific research, so that development is approaching more and more the ideal state of the endless non-rocking rail.

a. THE VIGNOLES' RAIL JOINT

The rail ends are prepared for autogenous off-hand welding, by gas cutting only, (Fig. 1). After having



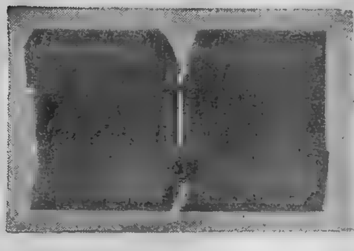


Fig. 1. Vignol rail joint prepared for welding

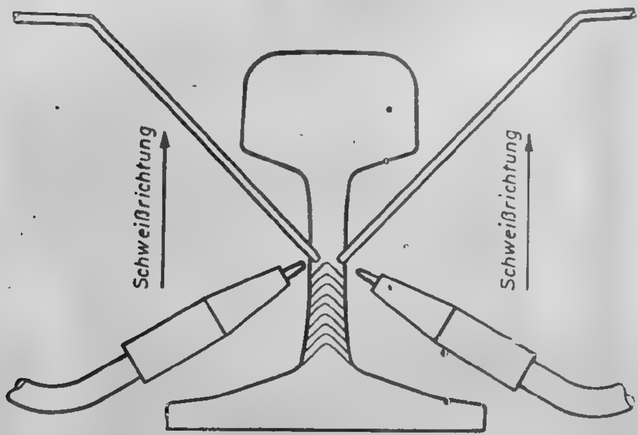


Fig. 2. Welding of the rail web

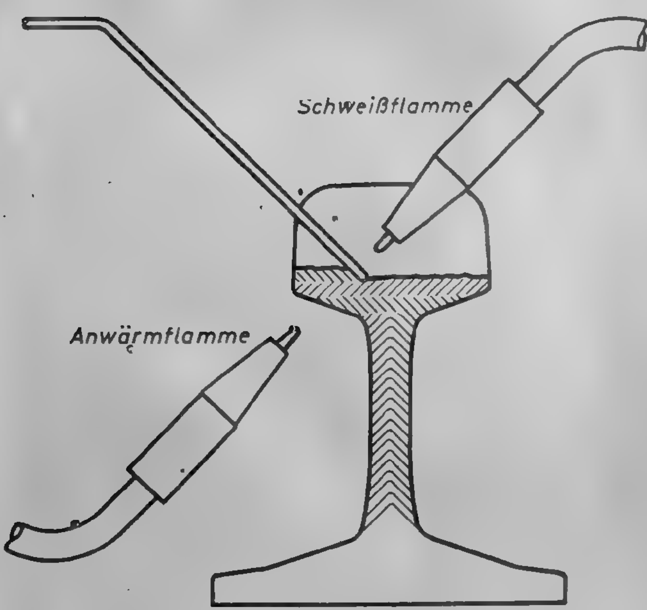


Fig. 3. Welding of the rail head

removed cuttings and oxide formations, the rails are straightened out by a ruler being at least 1 m. (abt. 3.28 feet) long. Immediately afterwards, the weld area is sufficiently preheated on both sides by two burners of 9 — 14 mm. (abt. 3/8″ – 9/16″) and welding of the web at the transition of the rail base to the web is begun. Two operators are working here on both sides simultaneously, (Fig. 2), using >GRIESHEIM< torches NORM of 4 — 6 mm. (abt. 5/32″ — 1/4″) and, at smaller rail sections, also with burner tips of 2 — 4 mm. (abt. 3/32″ — 5/32″).

The welding of the rail web is followed by welding the rail head. The rail head is multipass welded by both operators, using burners of 9 — 14 mm. (abt. 3/8″ — 9/16″) (Fig. 3).

After the first, second and third have been welded, the operation is, for a short time, interrupted and the work to be welded is hammered firmly in red heat. By this, the coarsely crystalline grain, proceeding from the welding process, is transformed into a fine-grained structure in order to give to the joint greater strength and elongation whereas the rail web as well as 2/3 of the rail head and the rail base are welded by means of >GRIESHEIM< GV–1 welding rods (filler rod for autogenous welding having a strength of 52 kg./mm.^{2} = 739,61 lb./sq. in.), the last third part of the runhead is welded by means of >GRIESHEIM< GA–3 welding rods (built up rod for autogenous welding of 250 kg./mm. = 3,555.814 lb./sq. in.)

Brinell hardness. The runhead is finished at once by smoothing the beads of the last layer by the burner and slag remainders as well as scale are removed by a planing tool and wire brush. The overhanging welding material is knocked off by means of a hot chipper. Finally the runway and the sides of the runhead are smoothed by means of a planishing hammer. The working operations are carried out so carefully, that the welding area does no longer distinguish itself from the rail that has not been welded.

After having completed rail web and head, base welding is commenced. Again two operators are simultaneously working, for the time being from the web outward. (Fig. 4). About three layers are welded into the base; at stronger sections, it may be necessary to weld a fourth bead.

In order to prevent imperfect welding from causing a rupture, the center layer of the rail base is, finally, rewelded from below. Such rail joints are, to a considerable degree, superior to the fish-plated rail

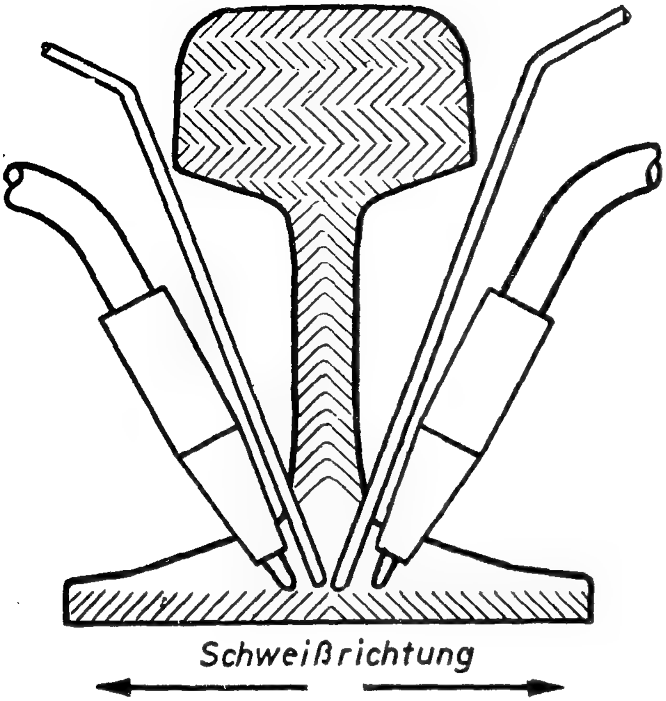


Fig. 4. Welding of the rail base

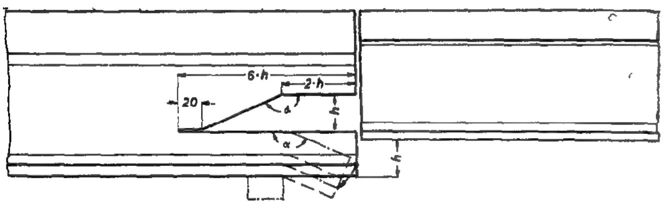


Fig. 5. Welding preparations on a transition joint by adjusting the bigger rail profile to the smaller one.

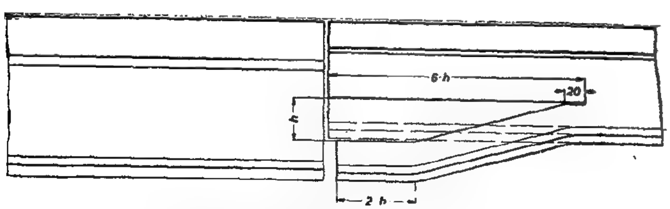


Fig. 6. Welding preparations on a transition joint by adjusting the smaller rail section to the bigger one.

joints. Tracks, exposed to extremely strong wear (curves, slopes) are often not equipped with standard rails, but with medium wear-resistant or wear-resistant rails. To these rails, as far as they are no head hardened rails, a so-called elastic cushion must be applied prior to the execution of the real joint welding by building up beads on both rail webs, by means of >GRIESHEIM< GV-I welding rods. Built-up welding is done by two operators on both sides simultaneously, right up from below. After that, the rail ends are straightened out and welded in the same way as a standard joint. When welding the rail web, care should be taken that weld beads do not reach the previous laid protective beads. Head hardened rails, as told before, cannot be welded because thereby a softening will take place, that will cause a road hole afterwards.

Rails being used already for a long time, show altered physical properties due to the strain-hardening and ageing and are liable to cracking when being welded. These rails are welded in the same way as those possessing higher grades of strength. In very unfavourable cases, protective beads can also become necessary on the bevelled sides of the rail base.

THE TRAMWAY RAIL JOINT

Tramway rails are prepared for joint welding in exactly the same way as Vignoles' rails. Only the furrow is additionally-double-V-bevelled. The welding order is the same.

THE TRANSITION JOINT

The continuous rail strengthening caused by the permanent increase of wheel pressure not only compelled constructors to use stronger materials, but also obliged them to enlarge rail sections. The double-butt strap joint or transition joint is extremely unfavourable because of the necessary crank since the joints are additionally loaded in shear.

This type of welding can be easily performed by the autogenous rail welding method, by which it is made possible for such transition joints to be easily reached by a nearly ideal flux of force and consequently a relatively high grade of creep strength is obtained.

When uniting two different sections with small difference in height, these requirements can be attained easily by cutting out a key of the higher rail's web, heating the base and pressing the rail together.

When larger differences in height are at stake (over 35 mm. - 13 13/16") the smaller rail section is reversely adapted to the larger one in welding a key into the smaller section (Fig. 6)

Fig. 7 shows a transition joint between a Vignoles' and a tramway rail and from this, we can also learn, simul-

taneously, about the working methods in welding transition joints.

Firstly head and base of both rails are prepared for welding by means of the gas cutter, in V-shape, just like welding an ordinary joint. Immediately afterwards, welding at the rail web is started exactly on the same spot, where later on the upper side of the cutting spot for the notch or cut out of the key-piece will be.

Not until then does the adaption of the small rail to the big one, or of the big rail to the small one take place. The cutting edge is welded tightly, the key piece is welded into respectively, and then follows the welding of the rail base and finally the welding of the remaining piece of the web is effected.

When the foot sides are strongly tilted the rail base corner of the projecting rail is cut off and a piece of plate, in conformity with the thickness of the rail base, is welded therein.

Thereby a satisfactory magnetic flux is attained. It goes without saying that the joints have to pass correctly from the rail base upward, just as with the standard joint.

At transition joints between Vignoles' and tramway rails in straight sections, it will be necessary to bend the spoon somewhat upward, after previous heating, in order to ensure a smooth wheel entrance into the rail furrow. In curves it is advisable to cut in the spoon slightly at the bottom, then, after previous heating bend off the furrow to a degree that a key piece can be fitted in and welded.

THE MANUFACTURE OF JUNCTIONS AND SWITCHES

In autumn of 1952 the "Bundesbahn" (West German Federal Railways) issued the first instructions for the manufacture of rails without interruption. What, however, applies to uniting rails, is also directive for building junctions and switches. These parts are very heavily stressed by the many connection points occurring within relative narrow limits and it will therefore, at a high working rate, be necessary to repair or to renew them at short intervals, as also keep them under careful observation. So here too prevails the tendency to change from the screw to the welding type of construction. Fig. 8 shows a junction with screwed mountings. The different points have been knocked out in the meantime in such a way, that renewal has become inevitable.

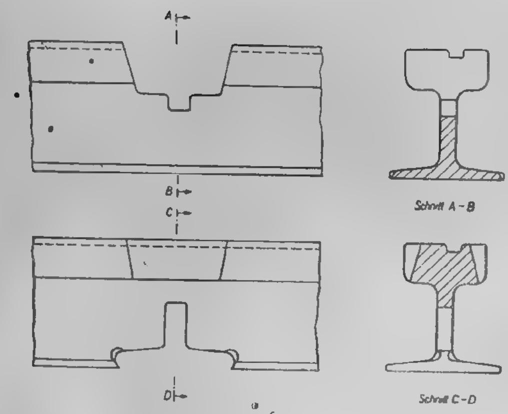
Fig. 7. Transition of a Vignol-rail to a tramway rail

Fig. 8. Junction with screwed mountings

The manufacture of a like junction made of heavy web rails (D180/105) with planed mountings will be briefly described hereafter.

At their points of junction the rails are cut out and laid into each other. Then each spot is welded by four operators, after previous heating, at dull red heat. Empirically it has been found to be effective to weld firstly both welded joints at the rail head. Immediately afterwards, the welded joints at the rail base and finally the fillet welds are welded by the four operators simultaneously right up from below.

Screwed switch points are working loose after a relative short lay-period, when not carefully and continuously maintained. If the maintenance work is discontinued, the guardrails and the pointed tongues at the change of track are speedily worn out and require repair by built-up welding.



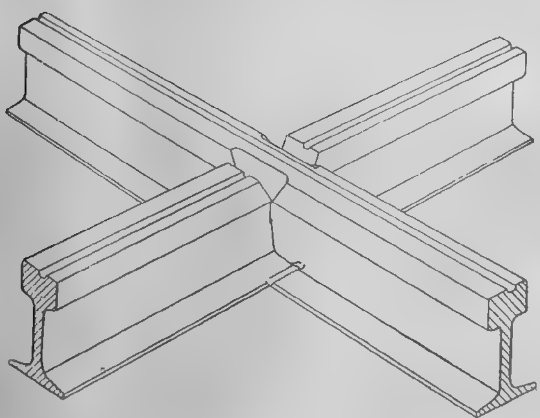


Fig. 9. Welding preparations at a junction of heavy web rails

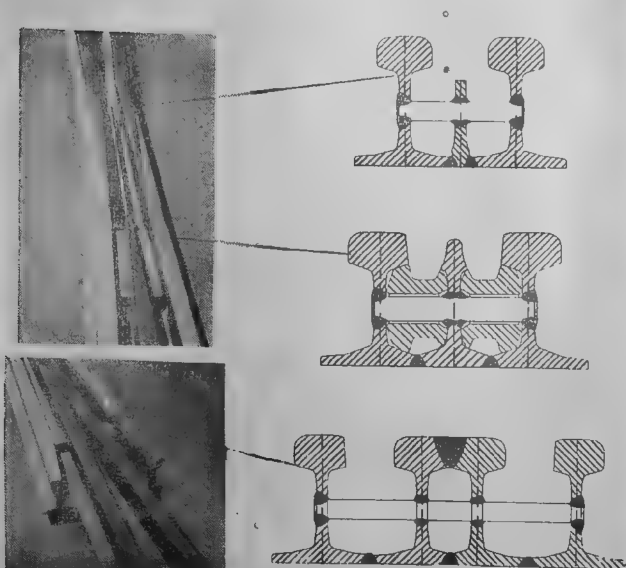


Fig. 10. Making a tongue – completely welded execution

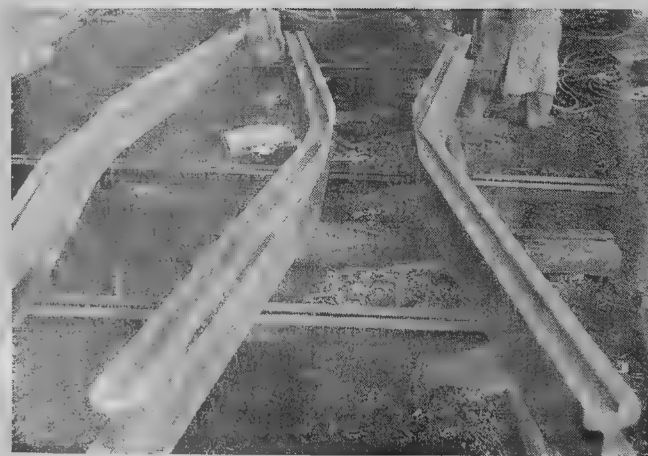


Fig. 11. Welding preparations at a mounting tongue consisting of heavy web rails

Fig. 12. Welded mounting tongue of heavy web rails

When joining, however, by welding technique, two rails in the form of a pointed tongue, a closed construction is formed by the welded joints at the rail head and base, that can obtain, by welding flat irons, an additional strengthening. When besides the guardrails are incorporated by satisfactory connections into the total frame, the rigidness of the workpiece is increased to such a degree that it will meet all requirements that will appear when it is being travelled (Fig. 10) upon.

Mounting tongues, employed mainly in tramway rails, can also be manufactured satisfactorily of heavy web rails. The rails are, for each junction, bent twice after previous pre-heating (Fig. 11) and finished accurately to gauge on the planing machine. Then head and base of both rails are welded by means of V-joints. (Fig. 12) Care should be taken that the distance between the two rail webs at the uniting points is as large as possible. Hereby a box mould possessing excellent physical properties will be formed.

It should be pointed out, that the main difficulties, when welding rail steel, are found in the hardening because of the formation of martensite. This hardening structure influences stability to a very unfavourable extent. When applying autogenous welding, this hardening is avoided since an amply measured zone is sufficiently pre-heated before commencing the welding work and by this a gradual cooling takes place.

THE BUILT-UP WELDING

Next to the junction tongue the switch point may be the most strained part of a switch, perhaps even of a rail altogether, and that is why it is liable to the largest wear.

Formerly when switch points had flattened to a certain degree they were removed and replaced by new ones. The dismantled pieces represented only scrap value. Sometimes single parts could be re-used. This in itself an expensive solution, still has the disadvantage that the new switch point cannot be adapted sufficiently to the other worn pieces of the switch in order to ensure the smooth crossing that is desirable and striven after. So it was obvious that a repair method should be developed that made it possible to recondition these switch points irreproachably and efficiently after having classified them according to their quality. This method has been found in the autogenous built-up welding. Apart from the switch points, the rail ends united by screwed fish plates are intensely stressed and flattened. The rails themselves too are damaged, so that an elimination is made necessary. All these repairs can be done correctly and efficiently by means of autogenous built-up welding.

The spots to be welded must be cleaned firstly by flame and wire brush so that they are free from oil and dirt. Immediately afterwards built-up welding follows with >GRIESHEIM< GA-3 welding rods by righthand side welding (Fig. 13). In sections of 8 – 10 cm: (3 1/8" 3 15/16") the weldings are effected and they are finished in the welding heat by means of a planishing hammer and forehammer. The execution of these operations can be done most efficiently at the rails in operation in order to

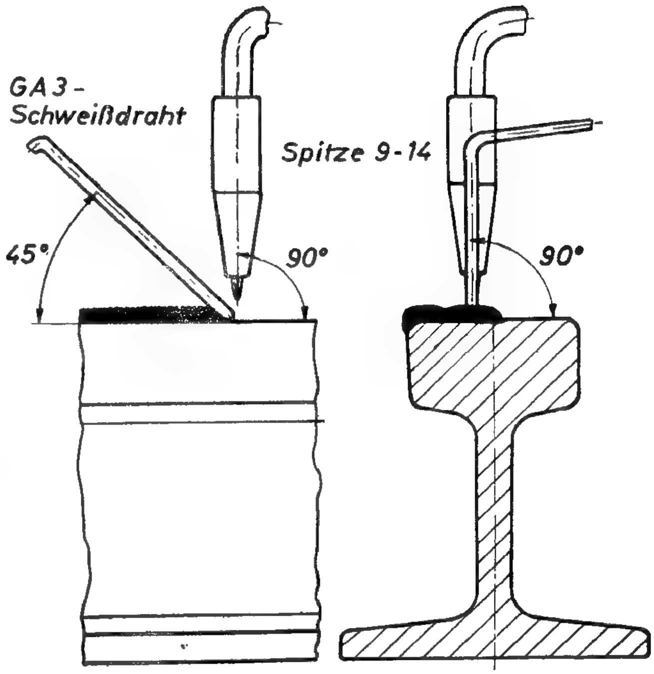


Fig. 13. Position of torch and wire when executing built-up welding on rails

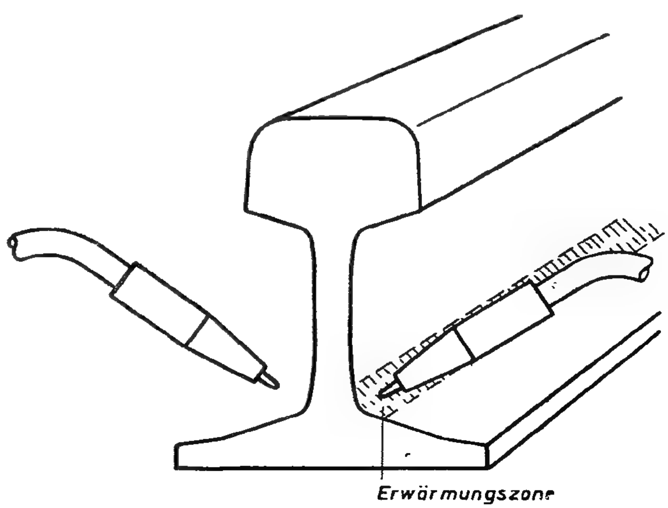


Fig. 14. Counter-heating of a shrunk-through rail

Fig. 15. Repairing the point of a tongue by the autogenous built-up welding

Fig. 16. Repairing a point of a tongue by the autogenous built-up welding

save the expensive dismantling and re-assembly. Interruption of the service will not be necessary.

The necessary height of the built-up welding as well as the control of a straight and smooth running surface after the welding and working, can best be done by means of a ruler of 1 m (3,28 feet) length. Should the rail, due to the welding, be shrunk through downward at the rail head, it has to be erected again by counterheating at the transition of the base to the web. (Fig. 14)

At the built-up welding of switch points a protecting bead is at first laid upon the point of the tongue, that has to be so high, that the guardrails are no longer touched by the crossing wheel. Thereupon the guardrails are

Fig. 17. Repairing a swith tongue by built-up welding on a rail in operation

Fig. 18. Built-up welding on tongues on a rotating device

built-up and worked in the described way mentioned previously and the point of, tongue is completed. The control of the correctly built-up height, with reference to

the general wear is effected by means of a form. The form is set up once at the point of tongue and once more at the spot where the point of tongue is 22,5 mm. (abt. $\frac{7}{8}''$) wide. (Fig. 15 and 16).

Finally a general control is made by means of the ruler in order to see whether the switch point, due to the welding, has been shrunk through downward.

This being the case the switch point is straightened again by corresponding counter heating.

The repair of switch tongues will be described shortly hereafter. It can be effected in the switch bed or after the switch has been removed.

Fig. 17 shows built-up welding of a switch tongue in the operational rail of a tramway. Here again built-up welding takes place in sections of 8–10 cm. ($3\frac{1}{8}''$–3 15/16″), the section is finished and the tongues are kept straight by counter heating. Built-up welding is best effected in the direction of the journey. If this is impossible, there will be a need for constructing an outlet at the built-up spot before a train is allowed to run over the tongue, so that the wheel rim cannot run up at the weld. Should the switch tongue show deep out-breaks or crumblings, the inferior layers must be welded with >GRIESHEIM< GV-1 welding rod and prior to that the upper ones with >GRIESHEIM< GA-3 welding rod.

After welding has been completed, there must be a control of the right adjacent to the stock rail. Rough spots are cleared by alignment through the welding flame. If the tongue protection of the stock rail has been worn out, or if it shows out-breaks, the repair has to be effected also by corresponding built-up welding. Should this be neglected it might happen that wheels, their bands being worn at the flanges, cut the switch open whilst running upon it and cause derailments of trains.

Numerous examples in tramway companies confirm, that switch tongues, repaired according to other welding methods, partly break out, partly break in traffic due to too high a tension and thereby give only a limited period of service. It stands to reason, that built-up welding in the switch bed is, due to unfavourable working conditions expensive, but still efficient.

To increase efficiency further, it is recommended, wherever possible, to apply built-up welding to demounted tongues only. Fig. 18 shows a device by which it is rendered possible to execute built-up welding at tongues of 11 m. (36′ 1″) long. It is distinguished by a sturdy construction. The apparatus is of swivelling design, the rotating movement being transmitted by a hand-wheel on to a worm and therefrom to a wormwheel. To store the switch device, that is connected to the tongue at the supporting bearer, it has been narrowed on both sides. The purpose of this device is, that all working operations can be executed in the horizontal position and that the operators are in a position to bring the device always in the desired position.

SYNOPSIS

The field of application of autogenous rail welding is very extended. Only the most salient applications could be set forth.

A remaining success in the undertaking of rail welding can only be ensured, however, if well trained, experienced experts are charged with such work. It is, however, an imperative necessity that these operators are steadily supervised and their executed work is examined.

GREATER USE OF KHADI ON RAILWAYS

There has been a five-fold increase in the purchase of khadi by the Indian railways during 1955–56, compared to the previous year. During 1955–56, the railways purchased khadi cloth worth about Rs. 34·5 lakhs, whereas in the previous financial year the total purchases amounted to Rs. 6.95 lakhs.

The Railway Board recently decided that, in future, mill-made *pugree* cloth at present being used should be substituted by suitable *pugree* cloth made of khadi. The current requirements of this type of cloth are estimated to be between 8,00,000 and 9,00,000 yards per year, estimated to cost between Rs. 10 and 12 lakhs per annum.

ALUMINIUM IN ROLLING STOCK

By R. K. Chari

THE use of aluminium in Railway rolling stock has developed rapidly during the last half century. Combining lightness and superior corrosion resistance with strength comparable to that of steel, aluminium alloys have a great advantage over traditional materials like timber and steel. Aluminium construction enables considerable saving in dead-weight, which can be utilised either to increase revenue-earning payload or to reduce fuel cost. The corrosion resistance of aluminium gives it durability and eliminates the frequent repair work necessary with other materials, which results in high maintenance cost and a considerable part of the available rolling stock being rendered idle during repairs. As a result of these advantages, aluminium construction leads to long term economies, which amply justify the extra initial cost involved.

COACHES

Direct substitution of steel panels by aluminium of the same gauge has resulted in a weight saving of 1 to 1½ tons per coach. This weight saving is of particular importance in air-conditioned coaches, which carry an excessive weight of installed equipment. Whereas steel panels, despite frequent repainting, have an average life of 6 to 8 years, aluminium panels will last, with norma maintenance, the life time of a coach, which is estimated at 30 to 40 years. In view of the non-availability of suitable steel panels, which have to be imported, and the advantages of aluminium, passenger coaches, built in India in recent years, have been extensively panelled in aluminium.

Use of extruded aluminium sections for structural members, now designed in timber and steel, offers ample scope for effecting economies. To consider a single case, the use of aluminium alloy extruded flanged channel sections bent to the contour of the coach roof-sticks, replacing timber filled steel carlines, will effect a weight saving of about 1,500 lbs., at no extra cost. The timber roof decking presently adopted may be retained as such or it may be replaced by aluminium roof sheets secured directly to the roof structure, which will result in a further weight saving of over 1,000 lbs., at an extra cost of about Rs. 800/-.

Adoption of a specially designed aluminium floor, in the place of the existing method of timber flooring covered with oxy-chloride compound, will save over one ton of dead-weight. The aluminium floor will comprise corrugated floor plates fixed to the underframe members. The upper corrugated grooves are then filled with cork and covered with long wearing Ferrobestos. Adopted extensively in modern stock in Europe and America, flooring of this type is giving excellent service in carriages imported into India for suburban systems.

Roof water tanks, fitted in coaches, are normally made in Zinc or galvanised steel sheets. Zinc sheets have to be imported, whilst the galvanised tanks, which are only about 25% cheaper, last not more than 6 to 8 years. Standardisation of aluminium tanks, which are already widely in use in Indian Rail Coaches, will ensure supply of clean and rust-free water and also reduce the dead-weight of a coach by about 600 lbs.

Rail coach windows, normally made in timber, easily warp under the extreme climatic conditions in India, resulting in jammed windows. Steel windows are difficult to handle due to their heavy weight of about 15 lbs. Aluminium windows, weighing only 5 to 8 lbs., have been developed to have the same sturdiness and life. Besides saving about 600 lbs. of tareweight per coach, they require little maintenance, are easier to operate, last longer and retain an attractive appearance throughout. Aluminium windows, louvred and glazed, have been tried out on a considerable scale in Indian Rail Coaches and have proven satisfactory.

WAGONS

Complete plating of a wagon with aluminium, costing about Rs. 1,200/- extra initially, will reduce the tare-weight by one ton. The value of the extra payload capacity thus made available cannot be over-emphasised in the context of the Country's expanding transport demands and limited wagon capacity.

The use of aluminium for the lower panels and flooring alone, where corrosion first sets in, will result in considerable savings in maintenance, achieved at an extra initial cost of Rs. 550 per wagon. This advantage is all the more important in the case of wagons transporting corrosive minerals and sulphurous coal.

Aluminium roofing of covered wagons will obviate the frequent replacement arising due to corrosion of steel,

(Continued on page 18)

NOHAB-GM locomotive to the Norwegian State Railways

In connection with a ceremony on April 25, outside the workshops of Nydqvist & Holm Aktiebolag (NOHAB), Trollhattan, Sweden, the first in a series of diesel electric NOHAB-GM locomotives was delivered to the Norwegian State Railways, represented by a delegation with Director General H. E. Stokke at the head of it.

As this delivery constitutes the beginning of the dieselization of a whole district of the Norwegian State Railways, the so-called Nordlandsbanen, the President and representatives of the Storthing (the Norwegian parliament), members of the Ministry of Communications, representatives for the Ministry of Finance and the Ministry of Commerce had assembled. Representatives for the press in Oslo and Trondheim as well as Norsk Telegrambyra and Norsk Rikskringkasting had also been invited.

After the delivery a tour around the NOHAB works was made where among other things the manufacture of the locomotives could be followed in detail.

From the delivery of the NOHAB-GM locomotive.

The flower-girl before handing over flowers to Mr. Stokke.

The locomotive now delivered by NOHAB is a streamlined bogie locomotive with 3 driving axles in each bogie. It is equipped with one driver's cab in each end and is arranged for single operator drive.

Together with the underframe, the body of the locomotive constitutes the supporting construction. Both the underframe and the car body are all-welded.

(Continued from page 16)

and will also permit an additional payload of ½ ton at an extra cost of about Rs. 200 only.

The use of aluminium in wagon construction, involving an initial extra cost of about Rs. 1,200/- per ton of weight saved, leads to a three-fold return : increase in payload, marked reduction in maintenance and improvement in wagon availability and reduced operating costs per ton mile.

In India, 100 wagons were plated in aluminium in 1949–50 and were put in service to examine the suitability of the metal. So far, they have suffered practically no corrosion and the results are heartening. For transporting wet coal ash, which corrodes steel very fast, the Calcutta Port Commissioners plated the bottom panels and flooring of their wagons with aluminium in 1953. Examination, after four years' constant service, revealed no signs of deterioration in the aluminium plates.

The diesel-electric NOHAB-GM locomotive, now delivered to the Norwegian State Railways.

The bogies are made according to the so-called flexi-coil principle with the axles displaceable in the journal boxes, which gives the locomotive an extremely smooth and even running.

The driving machinery consists of one V-shaped 1900 HP 16 cylinder 2-cycle diesel engine, manufactured by General Motors, USA. The power transmission is electric and consists of a generator direct driven from the diesel engine, regulation equipment, and D. C. motors, which by gears transmits the tractive power to the driving wheels.

The principle technical data are :

Max. speed	105 km/h.
Max. tractive effort	25 tons
Length over buffers	18600 mm.
Total wheelbase	14300 „
Bogie wheelbase	4000 „
Wheel diameter	1015 „
Weight in working order	98 tons

NSB (the Norwegian State Railways) have much experience of this type of locomotive. A NOHAB-GM locomotive of this type has since some years been in service in the Trondheim district. In spite of the difficult service conditions, very good results have been obtained.

According to an agreement in 1950 between NOHAB and General Motors (GM), USA, about the manufacture of diesel electric locomotives, NOHAB were secured diesel engines and electric equipment of GM's well-known make. NOHAB could at the same time benefit by all the operation results which the world's greatest manufacturer of diesel locomotives had acquired from the manufacture of more than 18,000 such locomotives. Locomotives of this type, supplied by NOHAB, are today rolling also on the railways in Denmark and Sweden. In Belgium 40 locomotives have been built to NOHAB's designs.

After NOHAB's works had been shown, dinner was had at the Town Hotel, whereupon the guests went back to Oslo by special train, hauled by the NOHAB-GM locomotive delivered to NSB.

NON-FERROUS CASTING PLANT

It is reported that the Electrical Manufacturing Company of Calcutta has set up a modern non-ferrous casting plant for manufacturing complete range of conductor accessories etc. required on transmission and distribution lines. Overhead equipment for railway electrification is also licensed to be manufactured by the Company. This is being made from various alloy metals in technical collaboration with French experts. The non-ferrous foundry reportedly employs most up-to-date techniques like gravity diecasting and pressure diecasting.

Activity of the Ganz Works in the field of Railway motorization

By I. Baranszky-Job, B. Sc.

Mech. Chief Designer

BRIEF REVIEW

THE Hungarian rolling stock has achieved special recognition in international relations too. As early as 1885 Hungary began its export activity and during the last 70 years the vehicles of Hungarian origin have gained a reputation throughout the world. The relatively small country supplied all kinds of passenger and goods trains, power vehicles, railcar trains and locomotives in the course of this period not only to European countries but also to Asia, Africa, North and South America.

The many years' result obtained cannot be attributed to ample raw material sources or even to privileged political situation but merely to the outstanding brain and physical works, proper design and careful delivery.

As a consequence of World War I and II the volume and the relations of capital of the Hungarian railway vehicle manufacture have been altered, nevertheless the present exportable wagon factories, first of all the Ganz Railway Carriage Manufacturers & Mechanical Engineers, Budapest, and the Machine and Wagon Works, Wilhelm Pieck, Gyor, as well as the Wagon Works of Dunakeszi – this latter working particularly for home demands — are marching ahead following the traditions of the Hungarian railway industry. In the field of locomotive fabrication the well-known MAVAG Locomotive and Machine Works, Budapest, continues its activity. The equipment of the electric locomotives are supplied by the Klement Gottwald Electrical Works, formerly Ganz Electrical Works. Besides numerous works and enterprizes are co-operating by manufacturing semi-products, components, etc.

It is characteristic for the technical development of the wagon works that the Ganz Works projected and designed the all steel eight-wheel passenger cars, the electric railcars manufactured for the Noord-Zuid Hollandsche Maatschappij firm in Holland as early as 1922, preceding thereby all the other wagon factories. Furthermore, the first Hungarian all-welded rail-vehicle has also been manufactured by the Gang Works in 1930.

In connection with the *power cars* Hungary has played a great part. The first steam — railcar of Hungarian origin, system Rowan has been built by the Ganz Works in 1883. This vehicle was in 1904 still in service. At the turn of the century numerous similar railcars of Hungarian origin were running on the lines not only of Hungary but even of the Russian State Railways, Bulgarian State Railways, Adriatico-Fermo-Amandola Railways, Belgian Royal Railways, as well as of the Japanese Railways. At the beginning of this century the Ganz Works manufactured cars driven by petrol engines. After World War I the Ganz Works was engaged with the development of the motorization. The first up-to-date power railbus manufactured in 1925 and delivered for the former Southern Railways was followed by the long row of modern railway vehicles. This result was greatly promoted by the high-speed Diesel engine, system Ganz-Jendrassik manufactured in 1928 and being in use all over the world without any alteration of the basic idea. Following this the eight-wheel railbus with up-to-date car body as well as the "ARPAD" type railcar (Fig. 1) had a great success in summer 1934 on their demonstrative journeys home and abroad. In addition this vehicle was the first running in international traffic communicating between Budapest and Vienna and covering a track of 260 km. during 2 h. 56 min.

Fig. 1. Eight-wheel railbus of the "ARPAD" type with 72 seats, manufactured in 1934 with 220 HP Diesel engine, system Ganz-Jendrassik.

The attention of the world was drawn by the economical and technical achievements and the Egyptian State Railways, Ferrocarriles Estado Argentino placed considerable orders with the Ganz Works already in 1934–35 which have been repeated at several times later on. A number of orders were booked from abroad, i. e. from the Buenos Aires and Pacific Railway, Central Argentine Railway, Uruguayan State Railways, Rhodesian Railway, South African Railway as well as from the nearer countries, i. e. Jugoslavia, Bulgaria, Romania, Belgium, etc. It may perhaps interest our readers that the former Indian North Western Railway has also placed an order for 11 railcars (Fig. 2) which have proved very satisfactorily in service.

After World War II large railcar trains and railcars with trailers have been ordered by the Soviet Union, Czechoslovakia, Poland, Germany, Bulgaria and last but not least by the Argentine State Railways, Jugoslavia, the Egyptian State Railways and lately by the Burma State Railways.

In connection with the highly developed technical state it is worth mentioning that among the purchasers of the licence of the Ganz-Jendrassik engines and Ganz railcar system have lined up even Belgian, French and remarkable British enterprizes besides the Roumanian, Polish, Holland and Spanish firms.

In the meantime locomotives, passenger and goods cars were exported throughout resulting that Hungarian hauling and trailing railway vehicles have been put into traffic in 18 European countries, furthermore in Asia: India, Anatolia, Siam, China, Japan; in Africa: Egypt, South Africa, Rhodesia, Marocco, and in America: Argentine, Uruguay, Chile, Canada and even on the lines of the United States of America.

LATEST PRODUCTS

The man of our age is particularly interested in the activity of the Ganz Works in the field of rolling stock development after World War II. From the following short summary appears that the factory traced its old and valuable traditions enabling it to match with the most renown firms of the world because of the proper construction and design of the vehicles accompanied by a careful and exact supply policy.

Following World War II the Ganz Works appeared on the world market with renewed type of railcar trains as a further stage of the development of railcar make.

The series of the 6-unit Diesel-electric trains for a gauge of 1524 mm. delivered for the Soviet-Union is of

Fig. 2. Eight-wheel railcar delivered to the Indian North Western Railways.

Fig. 3. Details of the interior of the railcar train delivered to the Argentine State Railways.

Fig. 3-a. Details of the interior of the railcar train delivered to the Argentine State Railways.

paramount importance. This train is capable to run long distances. The first and last unit of the train are railcars. Each railcar is equipped with a Ganz-Jendrassik Vee engine of 600 HP capacity serving as a basic engine, furthermore with an auxiliary engine of 200 HP. D. C. dynamos of max. 650 Volts are driven by the basic engines whereas the generators of 3×380 V with 50 Hz by the auxiliary engines. Each main dynamo supplies two traction engines. The top speed amounts to 110 km/h. The trailers are provided with compartments and the seats thereof can be converted into resting places. This train is apt for accommodating of 184 passengers, its weight in running order is 354 tons. One of the features of the train is the special air conditioning and heating equipment.

Continuing the above mentioned supplies for the Argentine 4-unit and 5-unit railcar trains have been manufactured for the Argentine State Railways, with a gauge of 1435, and 1676 mm., respectively. With due consideration to the long distances to be run the fatigues of travel are facilitated by comfortable seats the majority of which can be put in the direction of travel, furthermore by bars, dining rooms, (Fig. 3) etc. The 5-unit train has been provided with a complete air-conditioning equipment cooled by freon being the most suitable chemical product from the point of view of the health of the passengers. The spring system of the bogies consists of helical springs, respectively of helical and laminated springs, whereby injurious oscillations can be avoided. The friction vibration dampers inserted serve the same purpose. The trains with a gauge of 1435 mm. are designed to meet the increased travel demands and to be suitable for ferry-boat traffic as well. In order to secure this special projecting arrangements have been made in connection with the machinery equipment of the

Fig. 4. Unit railcar train delivered to the Argentine State Railways.

motive bogie enabling the Supplier to solve this problem in the most satisfactory manner.

Each of the three kinds of the trains is equipped with two railcars at the front and rear end of the train, to facilitate running in both directions of travel. The 4-unit train with 1435 mm. gauge is equipped with two engines; each engine is of the 8-cylinder and supercharged Ganz-Jendrassik type with an output of 425 HP. The 4-unit and 8-unit trains with 1676 mm. gauge are equipped similarly with two engines both; each engine is of the 12-cylinder and supercharged Ganz-Jendrassik type of 600 HP capacity (Fig. 4).

Remote-controlled railcar trains have been manufactured in 4-unit and 3-unit design for the Continent with a top-speed of 110-125 km/h (Fig. 5). The trains for a gauge of 1435 mm. provided with kitchen, luggage compartment, ample sanitary equipment, central ventilating and with independent heating per car, have apart from the dining room of 32 seats, 169, respectively 92 comfortable seats; some of these seats can be out in the direction of travel. The weight of the 4-unit train amounts to 194 tons, that of the 3-unit to 156 tons in running order, i. e. filled up with fuel and water. The train has two engines each being a 12-cylinder Vee engine with a capacity of 450 HP.

For the same purpose ten-wheel and eight-wheel railcars have been manufactured partially remote-controlled. The eight-wheel trains are provided with 8-cylinder engines (320 HP), whilst the ten-wheel trains with 12-cylinder Vee-engine (450 HP). Maximum axle load of the fully laden train approx. 13–15 tons.

Special mention deserve the narrow gauge (760,1000 mm.) trailers and railcar trains arousing the interest of the experts through the highly economic and technically perfect arrangement of the relatively large mechanical equipments.

The Hungarian rolling-stock industry has also not been left behind as regards projecting and make of the most up-to-date locomotives, i. e. of the Diesel locomotives.

Without paying special attention to the small locomotives of various gauges for industrial plants mention has to be made to the 400 HP hauling and shunting locomotives to be delivered for the Egyptian State Railway in a quantity of 100 pieces, furthermore to the 600 HP. main line locomotives with electric power transmission (Fig. 6). These locos are equipped with up-to-date Diesel engines, system Ganz-Jendrassik.

Fig. 5. 4-unit railcar train with dining room of 32 seats, 169 total seats delivered to the German Democratic Republic and equipped with 2×450 HP. fuel engines system Ganz Jendrassik.

Fig. 6. 600 HP Diesel electric locomotives type BoBo, manufactured by the MAVAG Works, Ganz Works and Klement Gottwald Factory in co-operation.

Though it rather embraces the electric industry, the overhead wire electric vehicles being hauling vehicles likewise, cannot be neglected. The mine locomotives with various gauges between 450–1000 mm. manufactured in single and twin design, have to be mentioned here as well. As to the electric tramcars and trailers very neat types have been manufactured by the Ganz Works. The former are designed in 8-wheel construction with high-speed motors and bevel gear power transmission driven by cardan shafts (Fig. 7).

FEW WORDS ABOUT DETAILS

It would be lengthy to propagate all the details embracing the numerous engineering inventions and skill

Fig. 7. Eight-wheel electric tramcar for accommodation of abt. 100 passengers.

Fig. 8. Power bogie of the Ganz railcars containing the main parts of the machinery equipment.

Fig. 9. Stress control of a steel car body by tensometric measurement with the aid of strain gauges.

leading to the present results. Perhaps it would be the Diesel engine vehicles which can rise some interest thus we would mention some data about the machinery equipment thereof.

The basic parts of the machinery equipment—Diesel engine, main clutch, gear box, reversing gear, axle driving mechanism—are housed in the power bogie representing an interchangeable unit to be easily dismantled and tested. Depending on the admissible axle loads the bogies are designed with two or three axles (Fig. 8). The auxiliary machines and equipments—water cooler, air compressor, lighting and auxiliary dynamos, possibly machinery part of the air conditioning equipment etc.—are in general arranged on the underframe.

The engines are of the Ganz-Jendrassik system Diesel engines with ante-chambers; bores: 170 mm. stroke: 240 mm. Speed of the engine: 1150–1250 r. p. m. Output approximately 40 HP per cylinder. The new types of the supercharged engines facilitate to increase the engine output by about 30%, increasing the mean pressure of the piston, making possible at the same time to produce engines with relatively low specific weight. They are vertically, in row or Vee-arranged. Some of the new types are suitable to be located also below the floor having a bore of 135 mm. The weight of the newest type for 1 HP amounts to 6-8 kgs. and 4, 5–7 kgs. for engines with steel and with aluminium crankcase, respectively.

The power transmission is, as a rule, mechanical. It consists of 3 basic parts, i. e. 1) main clutch, 2) gear box and reversing gear built together, 3) bevel gear axle driving mechanism of the driven axles. The gears of the gear box are constantly meshing and the several speeds can be switched by air compressed discs. The above vehicles are equipped with 5-speed gear boxes.

The machinery equipment of the railcars is generally electro-pneumatically controlled. The synchronisation of the machinery equipment arranged at both ends of the longer trains (e. g. full length of a four-unit railcar train for the Continent abt. 96 m, whereas that of the train for the Argentine abt. 130 m) has to be secured even at great distances and this can be performed with the present equipment. When having higher output the switches are automatically controlled in order to ease the driver's desk.

The bogies of the latest design being experimented nowadays by the Ganz Works to meet the various

demands still deserve mention. As to these bogie design we shall revert later and give an account about the experimental and practical experiences.

In order to supervise the up-to-date dimensioning of the railcar trains each type is subjected to extensive tensometric measurements during manufacture (Fig. 9) in order to be on the safe side as to the maximum safety combined with the minimum weight. Up-to-date vibration measurements are carried out for testing the running conditions of the trains in order to offer the greatest comfort to the passengers as based on scientific experiments as well.

Summarizing the aforesaid the reputation and practicability of the Hungarian railcars and trains can be attributed to the far reaching satisfaction of the railways' demands, recognition of the reasonable limits of. the weight decrease, due consideration of the maintenance costs when designing, service safety, proper arrangement, economic combination of solidity and neat appearance, proper design of the solid machinery of equipment, the distance switching, the remote control as well as the automatic control of hauling vehicles, furthermore to high efficiency and low fuel consumption, in other words to the many years' experiences and extensive export activity and last but not least to the proper application in practice of the recognized and employed basic principles of an industrial branch with old traditions.

U. S. MACHINE TOOL TEAM

The four-man team of U. S. machine tool experts currently on a month-long tour of India to survey the progress and future plans of India's machine tool industry is expected to visit several plants. The team's survey is in response to an invitation by the Union Ministry of Commerce and Industry. While their trip is jointly sponsored by the U. S. Department of Commerce and the U. S. Technical Co-operation Mission (TCM) in New Delhi, they represent the private machine tool industry of the U. S. They will make recommendations as to methods of improving the productivity of India's machine tool industry, both in the private and public sectors.

Railway Wheels and their Manufacture

FOR centuries after their invention wheels for transport were made of wood. With the advent of the railways, and the consequent heavier loads to be carried, stronger wheels were required. The first railway wheels were of cast iron throughout—a type still surviving in the U. S. A. in the form of solid cast iron wheels with chilled flanges and treads, though now being generally replaced by solid steel wheels. As the demand came for lighter wheels, combined with serviceable strength, various forms of spoke wheels came to the fore —the "hot spoke" type which was built of welded wrought iron throughout—the "cold spoke" type, having a cast iron boss, cast around wrought iron spokes, and its later development whereby the cast iron boss was superseded by a wrought iron boss forged round the cold wrought iron spokes. When means were provided by the Bessemer converter process of making mild steel in large quantities, cast steel spoke wheels were introduced. About 1895 the first steel disc wheel centres were rolled in Germany out of cast steel "cheeses". All these were wheels requiring either a wrought iron or steel tyre fastening on; usually by a process of shrinking a hot tyre on a cold wheel centre. At this time the chilled iron wheel was in general use in the U.S.A. In 1899 Mr. C. T. Schœn was making pressed steel rail cars of 100,000 pounds capacity, having eight wheels per car. The chilled iron wheels were not satisfactory at this heavy loading and the services of an engineer who had designed a disc wheel centre rolling mill in Germany were called upon. This designer thought that by using a grooved tread roll it might be possible to roll a wheel with a flange on, that is, a solid wheel. Such a mill was built in the U.S.A. and put into service in 1903 with complete success.

Wheel Slabbing Press.

Solid wheels, as their name implies, are solid throughout; that is the whole wheel, tyre portion, web, and boss are all wrought out of one piece of steel, though it can be arranged that the hardness of the steel may vary in the different portions of the wheel. They possess considerable advantages over the "built up" type; to name a few :—The chief one is that the first cost is lower. The reason for this is obvious—the built up type of tyre and disc centre requires the employment of two rolling mills in the manufacture of these parts. Subsequently the tyres have to be bored, the disc centres topped, the one shrunk on the other, and the retaining ring inserted and the lip rolled down — quite an elaborate process, by comparison, when one considers that for very little more than the extra cost of the steel in the tyre the same disc mill might be employed in rolling the solid wheel complete with tyre on. This question of cost over a period of years is of importance. A simple calculation shows that a first cost saving of say 10% becomes a very considerable figure in compound interest over the life time of a wheel. Another advantage is that the solid wheel can be made lighter than the built up type. Weight saving is important—it is non-paying load—and any increase of weight means more tractive effort on the part of the locomotive. Again it is unsprung weight in a wheel—a lighter wheel leads to less wear and tear on the track.

Solid wheels are made in three general types—an ultra-light known as a "One Wear" type, which has a limited life and is then removed from the axle and replaced by a new wheel. This type is obviously of use where weight saving is most important and is economical only where the value of scrap steel is high. Next is a "Multiwear" type, which, when tread and flange are worn, can be placed in the wheel lathe and re-formed without removal from the axle. A heavier type still is "Retyreable", which after several re-turnings in the wheel lathe can finally have the wheels machined into centres on which

6,000 ton Wheel Forging Press.

new tyres may be shrunk without removal from the axles.

All the above solid wheels are manufactured by a similar method. Steel is made either by the acid or basic Siemens Open Hearth process and cast into six, eight or twelve sided ingot moulds by bottom pouring through a refractory lined funnel and tubular runner bricks to avoid surface defects due to splashing. After cooling the ingot requires cutting into appropriate block weights to make a wheel. This is done by a very heavy type parting lathe using a pair of tools, one sharp pointed V tool to split the turning and one straight tool in each cut, and cutting down to about five inches diameter when the ingot is removed and broken into blocks by the insertion of a wedge in each cut. The top or head of each ingot and a length from the bottom are cut off and scrapped to ensure that only first quality steel is in the block. Another means of obtaining the lumps or blocks is by breaking the ingot. For this a special type of ingot is required of such a weight that each wheel block is about one quarter the weight of the whole ingot. The ingots are nicked circumferentially, half way round only, in three places to a depth of ¼ inch by means of oxy-acetylene, using a length gauge and are placed on a heavy block of steel and supported on rollers and a weight dropped on the middle. Alternatively, breaking is done by applied pressure under a press or in a machine. This breaks the ingot in half. Positioning rams move the ingot longitudinally on rollers and each half is then broken into quarters. Three blocks are obtained from each ingot and the top quarter of the ingot containing the pipe cavity caused by shrinkage in casting is discarded.

The wheel blocks are then gradually heated to a forging temperature of 1200°C. either in a continuous pusher or bogie type furnace from which they are withdrawn by a manipulator and placed upright beneath a heavy forging press. Here the block is upset forged inside a floating steel ring into a circular slab. Then the slab is conveyed to another press which forms it in dies to the rough shape of a wheel but a few inches smaller in diameter than the finished wheel—about 6,000 tons pressure is required to do this. After pressing the wheel block is punched and then reheated before being placed in the rolling mill. Here conical driven rolls engaging the web portion of the wheel spin it around a mandril which is inserted into the bore of the wheel. Pressure is applied to the web rolls and the web is reduced in thickness—at the same time a third but free running box section roll, having a flange groove in it, is applied by pressure on to the tread of the

Wheel Rolling Mill.

Wheels entering Heat Treatment Furnace.

wheel, just behind the line of contact of the conical rolls in the web. The wheel increases in diameter through the tyre portion being reduced in thickness and material flowing from the tyre in the web. Meanwhile two more undriven rolls control the width of the tyre. On the desired diameter being attained the wheel is removed from the mill and placed between contoured dies under another hydraulic press and given a squeeze. This both makes the wheel truly round and forms the web to a cone section thereby increasing the lateral rigidity of the wheel. The next process is heat treatment. Immediately after rolling the wheel is allowed to cool in air to below the recalescence point of the steel, to about 600°C. and then pushed on bogies through a continuous furnace until it attains a normalising temperature of about 830°C. at the withdrawal end. On removal from the furnace it may either be placed beneath pans and allowed to cool slowly or alternatively be put on a rotating table machine and water sprayed on the tread and flange to harden the wearing portions,. followed by panning. After testing for soundness by a falling weight destruction test, and tensile test, of representative samples, the wheels are subsequently machined in automatic contour turning lathes and after being mounted on their axles are ready for many years of service on the railways.

TISCO PRODUCTION IN MAY, 1957

Total approximate production of iron and steel at the Jamshedpur works of Tata Iron and Steel Co., Ltd. during the month of May last was as follows: Steel ingots 86,600 tons and saleable steel 65,100 tons comprising 16,200 tons of semis and 48,900 tons of finished steel. Pig iron production during the period totalled 91,300 tons.

"Perlitionising" Process for your Case Hardening Work

THE very great advantages of "Perliton" for case hardening work, are already well-known to Heat Treaters, throughout the world. Many plants in India have adopted the "Perlitionising" Process for their case hardening work, which is a very much more rapid process to the normal pack hardening methods—especially for small parts.

As is probably well-known this somewhat revolutionary case hardening material was supplied in two separate parts :—

'Perliton' Liquid Heat ; and

'Perliton' Carbon.

The 'Perliton' Liquid Heat had to be first dissolved, and then the "Perliton" Carbon was added to the liquid bath, and formed a crust on the top of the Liquid Heat.

Subsequently it was found practicable to supply 'Perliton' Liquid Heat and 'Perliton' Carbon combined into one material, which was found much easier for those using the 'Perlitionising' Process to operate, and control the quantities necessary of both products to make up the carry-away losses inevitable in the operation.

Further very extensive experiments have been recently carried out, and the latest developments in the 'Perlitionising' Process, has been the production of what one can call a "one piece" water soluble carburizer, which will be now known as :—

Perliton 400

and which possesses a high carburizing value.

This high surface hardness values, with shallow case depth, are not brittle, because of a full eutectoid composition and the absence of excess carbon or carbides afforded by this product. 'Perliton' 400 supplies a rapid rate of carbon penetration at low carburizing temperatures and short immersion circles. When needed, however, deeper case depth can be obtained by means of using a higher operating temperature.

CASE DEPTHS

Although all steels do not carburise, or case harden, at the same rate, the following penetrations which are obtainable at various time and temperature cycles, will enable those interested in the subject, to better understand the advantages of this definitely revolutionary case hardening product :—

Temperature @ 1500°F		*Temperature @ 1550°F*	
15 minutes	.004"	15 minutes	.0057"
30 ,,	.005"	30 ,,	.0088"
45 ,,	.0075"	45 ,,	.0110"
1 hour	.0088"	1 hour	.0132"
2 hours	.0110"	2 hours	.0178"
3 ,,	.0154"	3 ,,	.0220"
4 ,,	.0198"	4 ,,	.0264"

Temperature	*@ 1600°F*	*@ 1650°F*	*@ 1700°F*
15 minutes	.0066"	.0088"	.0099"
30 ,,	.0088"	.0132"	.0152"
45 ,,	.0132"	.0154"	.0176"
1 hour	.0154"	.0176"	.0220"
2 hours	.0196"	.0264"	.0330"
3 ,,	.0242"	.0330"	.0396"
4 ,,	.0286"	.0440"	.0506"

ADVANTAGES

"One piece" water soluble carburizer ; reduces need for control tests.

Long lasting, highly stable bath.

Provides eutectoid type case of uniform depth.

Flexibility of use and rapid carbon penetration.

Work is more easily cleaned, because of the water Soluble nature of the compound.

Low drag-out or carry losses, thus reducing operating costs.

Undoubtedly this entirely new type of case hardening material is going to be of the greatest use in India, where industrialisation is slowly begining to have an important place in the economic life of the country,

HYDRAULIC BUFFER STOPS

CONTINUOUS brakes are now relied upon so much that even partial failure when a train is entering a terminal station or dead end may entail a quite serious accident. On the score of safety and freedom from claims to damages therefore it is in the general interests of railway companies to adopt buffer stops that will effectively absorb the shock of collision without causing injuries to passengers or damage to rolling stock. It is more than 70 years ago that the invention of the hydraulic buffer stop provided the complete solution to this problem and it is still the only type of buffer that will give smooth retardation over its full stroke without recoil. Many railway companies in all parts of the World have installed them in their important terminals as a protection against serious accidents due to over running (some of the major installations in India and Pakistan are listed at the end of this article). On the score of safety to passengers and property, they claim the interest of all railway companies as they have proved themselves satisfactory time and again under many varying conditions.

The length of stroke of a buffer stop is of prime importance and after much experimenting in the early days it was found that the smallest size, to be of any real protection on a standard gauge railway, should have a stroke of 5 feet. A pair of hydraulic buffer stops of 5 feet stroke is capable of bringing to rest safely a train of 200 tons weight running at a speed of 6 miles per hour or any other combination of train weight and speed requiring the same retardation effort to bring it to rest in 5 feet.

The minimum distance in which a train can be brought to rest safely from a given speed depends firstly on the ability of the train's structure and passengers to withstand the effects of the retardation and secondly on the constant application of the maximum permissible retardation force throughout the full stroke of the buffer stop. The action of the hydraulic buffer stop is exceedingly simple. The front casting of the cylinder projects forward to support the piston rod which is fitted at one end with a buffer head and at the other with a piston working in the cylinder. The cylinder is completely filled with water, passages being arranged so that the volume of water behind the piston can pass gradually to the front side as the piston is forced back. When the piston is first set in motion at the same speed as the train striking the buffer, a pressure is set up behind the piston opposing the movement of the train. The water passages are much larger at the front end of the cylinder than at the back and consequently, as the speed is checked, less and less passage of water is provided resulting in a constant resistance being maintained to the motion of the train till it is brought to a standstill.

As the piston rod is forced home an amount of water equivalent to the volume of the rod entering the cylinder is displaced and ejected from the cylinder through a relief valve provided in the front casting. It is usual to provide a water drain in front of the buffer stops to carry off this water.

It will be seen from the above that the only parts subjected to heavy pressure or loads are the cylinders, pistons, rods and buffer heads.

A constant supply of water is connected to the front part of the cylinder and acting on the back of the cylinder forces the piston rod outwards thus automatically re-setting the buffer immediately the train is backed away. A pressure of about 35 lbs. per sq. in. is all that is required so that connection to an ordinary water main is usually sufficient for this purpose.

Where an ample supply of water is not always available or it is undesirable to run the water to waste when the buffer stop is operated, the automatic re-setting can be arranged by the displaced water being forced into a receiver fixed to the front casting. The return stroke is then automatic when the train is backed away from the buffer stop as the pressure which has been built up in the receiver, automatically returns the water. This type of stop is also arranged for use with oil instead of water which has some advantages.

The type of hydraulic buffer stop described above is known as the compression stop, being made in sizes up to 11 feet stroke. A pair of 11 feet stroke stops is suitable for bringing to rest a train weighing 890 tons when travelling at 10 miles per hour and it is interesting to note that at this speed the sensation of a train colliding with the hydraulic buffer stop is very similar to that felt when the Westinghouse brake is put hard on.

The weights and speeds of trains continue to increase, however, and the danger of over-running the heavier trains at higher speeds necessitates buffer stops with even longer retardation strokes if the trains are to be brought to rest without damage. For mechanical

(Continued on page 38)

Materials Handling with Ransomes Trucks

RANSOMES Electric Industrial Trucks derive their worth from two main sources.

(*a*) *Their High Use Value.* The ability to serve production lines, to keep pace with rigorous schedules and to avoid bottlenecks where hold-ups cost money by the minute; their high availability for service.

(*b*) *Low Operational Costs.* Battery power costs less than any other form of power. No power is used when the truck is not actually stacking or moving.

The above summarises the experience gained by Ransomes since entering the industrial truck field.

The original Ransomes battery-powered truck, had three wheels, the single drive wheel being at the rear where the operator stood and the two steering wheels were on the front axle. The platform was fixed and carried up to 2,240 lbs.

Soon followed the desire, not only to transport heavier loads, but also to move them faster. This led to the development of a low-lift platform truck which took on the name of "elevating truck". Stillages, were, and still are, used in conjunction with the elevating truck thereby increasing the efficiency of the truck by avoiding loss of time loading and unloading.

Then came the high elevating or tiering truck, the purpose of which was to lift loads high enough to place them on road lorries or works inspection tables etc. Usually loads could be lifted up to a height of 5 to 6 feet. Then followed various types such as, crane trucks, hopper trucks, stevedoring trucks and the like. It should be remembered that there are many handling jobs which will continue to be done with great efficiency with the above types of trucks or by a tractor-trailer system.

The fork truck was originally designed to handle tinplate but its adaptability for service in other industries and for handling other types of loads soon made it universally popular.

The first Ransomes forklift, or tinplate tiering truck, was made over a quarter of a century ago and is still in service in the tinplate industry of South Wales. Many of the same type were supplied. These trucks had a non-telescopic mast and the lift was operated by an electric motor and double reduction worm gear; steering was by tiller arm and the operator stood at the rear.

With the advent of the modern forklift, materials handling came of age. Great progress has been made in the mechanization of handling operations in industrial plants and warehouses and in many cases, development in this direction has been as thorough as production mechanization. However, there are many places where trucks are used only in the most obvious applications and when searches are made, opportunities for economy in handling operations are found to be almost limitless.

The present range of Ransomes trucks include the following :

(*Continued from page 36*)

reasons it is not practicable to build compression hydraulic buffer stops with longer strokes than 11 feet and it has been necessary, therefore, to adapt this principle of hydraulic retardation—the only satisfactory way of obtaining smooth operation—to buffer stops having much longer strokes. A tension type buffer stop has been designed and patented by Ransomes and Rapier Limited, Ipswich, England, who were also the original inventors of the compression hydraulic buffer stops, incorporating the well tried hydraulic retarding principle but with the piston rod arranged in tension thus making possible much longer strokes than when the piston rod is in compression. This Tension Buffer Stop retains all the old features of smooth retardation and automatic re-setting after impact. A long stroke hydraulic buffer stop of this type having a stroke of 17 feet and capable of bringing to rest a 300 ton train travelling at 13 miles per hour without dangerous shock and recoil, has been installed at Aldgate East Station in London and over a number of years has proved entirely satisfactory.

It will be of interest to readers to know that Ransomes and Rapier Limited suppliers to Indian Railways of Cranes, Turntables, Traversers and other Railway Plant over many years, have installed a larger number of hydraulic buffer stops in India and Pakistan notably at Madras Beach Station, Victoria Terminus, Bombay, Baroda Station, Chittagong Station and Karachi Terminus.

PLATFORM TRUCKS

Type	*Description*	*Payload (Lbs.)*
TE	Fixed or elevating platform. (hand operated hydraulic gear).	2240
NU or ENU	Fixed or elevating platform. 2 or 4-wheel steer.	4480
NUH or ENUH	Fixed or elevating platform. 2 or 4-wheel steer.	8960
TNU	High elevating platform. 2 or 4-wheel steer.	4480
S	Fixed platform stevedoring truck. 2 or 4-wheel steer.	4480
NU CRANE TRUCK	Fixed platform. Jib capacity 1120 lbs. 2 or 4-wheel steer.	3360
NU HOPPER TRUCK.	Equipped with hopper for sand, cement, etc. Side or end tip. 2 or 4-wheel steer.	4480

TRACTORS

Type.	*Description.*
TE	Hauling capacity—up to 5600 lbs. on hard level ground.
T4	22,400 lbs. hauling capacity on hard level ground.

The list of platform trucks could be sub-divided according to platform area and height.

The Ransomes battery-powered forklift trucks are as follows :

FORKLIFTS

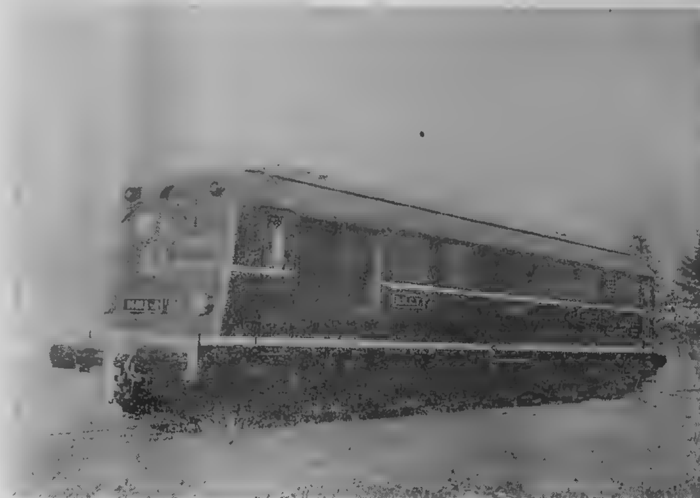
Type	*Height of Lift.*	*Payload (Lbs.)*
FL. 10	8, 9 or 10 feet	1200
FL. 2000	8, 10, 12 or 14 feet	2000
FL. 3000	8, 10, 12 or 14 feet	3000
FL. 4500	8, 10, 12 or 14 feet	4500

Various types of attachments and accessories are available :— load guard, fork extensions, operators overhead load guard, crane attachment, ram or bar attachment, side shifter, lighting equipment, pipe lifters, load clamp, carton clamp, rotating head, paper reel clamp and an automatic load guard for bottle crates.

Twentyfive years of progress in construction of Shunting Locomotives

*(We have pleasure in reproducing below a short write-up in respect of Shunting Locomotives. These Locomotives are constructed by a leading firm Messrs. Compagnie des Ateliers et Forges de la Loire in France which has twentyfive years of leadership and experience in the construction of such locomotives. We are sure this write-up will be of interest to our Engineers.—*EDITOR*)*

THE Cie des Ateliers & Forges de la Loire (C. A. F. L.) stands as one of the leading French Industrial concerns, the activities of which cover a wide field in Siderurgy and Mechanical Engineering.



Diesel Electric Locomotive—Type CoCo 2000/2300 HP.

Diesel Electric Locomotive—Type BoBo 600 HP.

For the past 25 years the C. A. F. L. has specialized in the construction of road and shunting locomotives equipped with various types of transmissions electrical hydraulic or hydromechanical. One of the most powerful Diesel Electric Locomotives (4400 hp. in two units) was built in 1933 in the Company's works. Before the electrification of the railway between Paris and Lyon it travelled 100.000 Km. in 100 days on this line.

Taking into account the results obtained in this field, the C. A. F. L. after the 1939–1945 period, followed the evolution of technique in order to obtain the best selling prices and to improve constantly the performances without any diminution of robustness. A large number of locomotives in use on the French National Railways, overseas and in the private industrial works, have been built by the C. A. F. L. The main recent units in the field of Diesel Electric locomotives have been equipped with the Cie Electro Mecanique (Brown Boveri) drives and Sulzer engines viz :

—55 500/600 b. h. p. 060 type Shunting Diesel Electric locomotives for S.N.C.F., Subway, Loire Collieries, etc.

— 8 600 b.h.p. BoBo type Shunting Diesel Electric Locomotives for Siderurgic Works.

—35 2000/2300 b. h. p. CoCo type Diesel Electric Locomotives for S. N. C. F.

— 3 700 b. h. p. BoBo type Diesel Electric Locomotives for the Mediterranee Niger system.

Lately a series of 25 shunters 200/300 b. h. p. 040 type have been built for various private and public services fitted with engines of different makes and Cie Electro Mecanique drive.

Moreover the C. A. F. L. is manufacturing with the

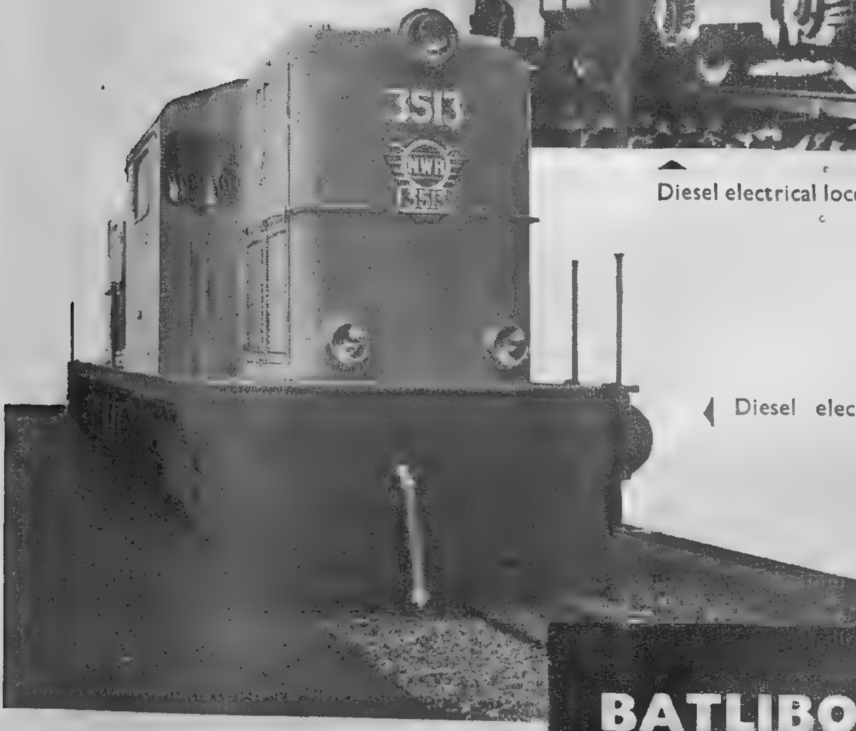
(Continued on page 43)

BATLIBOI & CO.
REPRESENTING LEADING FRENCH MANUFACTURERS

Alsthom

DIESEL ELECTRIC LOCOMOTIVES

Diesel electrical locomotive for Spain, 50 tons, 930 B.H.P.



Diesel electrical locomotive for Pakistan, 68 tons, 825 B.H.P.

ASSOCIATES
BATLIBOI Private Ltd.
Bangalore & Secunderabad-Dn.

BATLIBOI & CO.
Forbes Street, Fort, Bombay

Branches:
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Ahmedabad - Kanpur - Vijayawada

SISTA'S B-94

Type BB 68 tons Locomotives for the Pakistan Railways

THE Pakistan Railways have ordered 18 locomotives, type BB, of 68 tons which are being built in the Works at Tarbes and the delivery of which was begun in August 1954.

These locomotives only differ from the « Holland » type in the following respects:

1. The gauge of the track is 1.676 metres (5' 6");

2. The Diesel engine is of the type SGCM 16 V 12 PA, designed for a continuous power output of 750 HP and 825 HP on a one-hour rating. Its effective useful output in Pakistan will be 675 HP on the system at low altitude, and 625 HP on the high-altitude system at 1800 metres (5905');

3. The weight has been brought up to 68 tons by increasing the thickness of the steel foot-plate;

4. The gear ratio is higher; none the less, it enables a maximum speed in service of 70 km/h (43 m. p. h.) to be obtained with the following tractive efforts:

At steady speed : 10400 kg (22930 lbs.)

At starting : 18000 kg (39700 lbs.)

The control equipment is of the single-unit type with a single control desk providing continuous pneumatic control of the speed of the Diesel engine.

The braking equipment is of the mixed type compressed air-vacuum; the locomotive is braked by compressed-air (compressor Jourdain Monneret A 800) and the load hauled by vacuum (Spiros Vacuum Pump 2 NMV) with a synchronising valve. A supplementary vacuum pump, driven by an electric motor, enables rapid release of the brakes to be obtained.

As the locomotive is required to operate through sandy regions, the doors of the hoods in which openings are formed for the intake of ventilating air for the various machines, are provided with filters.

This type of locomotive is essentially intended for shunting duty.

Finally, the Works at Belfort and Tarbes have under construction 62 BB locomotives for metric tracks intended for various railway systems in Africa and in Spain:

— 9 for the Madagascar Railways;
—12 for the Cameroons Railways;
— 6 for the Franco-Ethiopian Railways;
—15 for the Dakar-Niger Railways;
—20 for the Spanish Railways.

The locomotives for the first order placed on the 14th October 1953 were delivered between March and June 1954 (6 months between the date of order and the delivery of the first machine).

These locomotives are shorter in length than the standard or wide-gauge machines, because of the suppression of the small hood which serves no purpose, the heating boiler not being considered necessary for these systems; they have an unladen weight of 44 tons, or 46 tons with a supply of 2000 litres of gas-oil; in addition, they can be increased by ballast up to 54/56

(Continued from page 41)

collaboration of the Society " ALSTHOM " acting as workmanship master 53 1800 b.h.p. CoCo type Diesel Electric Locomotives for S. N. C. F., Algerian Railways and Argentina Railways.

Researches are being undertaken in connexion with the Regie Renault and the Society Sigma for the building of 2400 b. h. p. Locomotives comprising Sigma Pescara gas generators and Rateau gas-turbines.

On the other hand the C. A. F. L. manufactures Railway Material as castings, tyres, springs, forgings, fittings and the many other parts which enter into the building and the maintenance of rolling stock and track. Particularly the C. A. F. L. is specialized in the manufacture of switches and crossings cast in manganese steel.

tons which means that they are suitable for all the metric-gauge systems which demand 11 to 14 tons per axle, which is the general case.

The metric-gauge bogies have a small wheel-base (2200 mm.—7' 3") which enables the machine to adapt itself to tracks having a small radius of curvature; in addition, those which are intended for winding lines are provided with greasers for the wheel flanges or for the rails so as to reduce wear on the flanges.

The maximum speed in service is 70 km./h. (43 m. p. h.).

The Diesel engine is of the type MGO 12 V SHR provided with an altitude turboblower; the useful power overseas is 730 HP for the systems which do not exceed 1700 metres (5577') in altitude; for the Franco—Ethiopian Railways (which reach 2400 metres—7874'), the output fixed is at 675 HP.

The electrical equipment is identical to that of the Pakistan locomotives (single unit); the motors operate at full field and with 50% parallel connection when the locomotives are ballasted to 52/54 tons; when the locomotive weighs only 44 tons, running with full field is replaced by a small shunt connection of 30%; this enables the tractive effort to be adapted to the adhesive load without changing in any way the adjustments of the generator.

The tractive efforts obtainable are thus as follows:

	At steady speed	At starting
Locomotive of 52/54 tons	8000 kg (17640 lbs.)	13000 kg (28660 lbs.)
Locomotive of 44 tons	6800 kg (14990 lbs.)	11000 kg (24250 lbs.)

The compressed-air equipment is similar to that of the Pakistan locomotives, and comprises a compressor A 800 and a vacuum pump 2 NMV. When the machine is provided with greasers for the wheels or the rails, a second compressor, type A 800, is added to the equipment.

Internal Lubrication of Steam Locomotives

[*Contributed by Caltex (India) Limited*]

THE proper choice and use of lubricants forms an indispensable part of the steam locomotive. The lubricant in a bearing serves as important a duty as the metal surface of the bearing itself, which would promptly 'burn out' if no lubricant were present. Not only is excessive wear produced in a steam cylinder by lack of lubrication but also steam leakage results. The long life and service rendered by any machine or moving part is entirely dependent upon the selection of correct lubricants. Correct lubrication is the prime factor of profitable railway operation. Due to the economy of correct lubricants these benefits are secured at little or no increase of cost per mile of operation.

The investment involved in the locomotives of any railway is necessarily large. Returns from this investment are largely dependent upon correct lubrication, which lengthens the life of every engine, reducing the rate of depreciation. Maintenance costs are largely due to necessary repairs of the worn parts. Correct lubrication reduces wear to a minimum.

Let us here consider the internal lubrication of locomotives in terms of valves and cylinders.

Internal lubrication of the locomotives has two main purposes :—

1. To reduce friction and wear of valves, valve seats, valve stems, pistons, cylinder walls, and piston rods, to a minimum.
2. To provide an effective oil seal for all these parts to resist steam leakage.

Effective internal lubrication is the result of a series of conditions, each one of which must be favourable if the best results are to be obtained. The oil must be introduced at the proper place and in the correct amount. It must be adequately yet uniformly, distributed or spread over the surfaces to be lubricated. The oil must be adapted to the method of introduction, and distribution, and must possess all the characteristics required for its functions as a Lubricant and sealing medium, and must resist whatever film-destroying conditions are encountered.

If water condensation is present, the oil must still adhere to the surface and form a satisfactory film in spite of this condition. Steam temperatures, and temperatures of lubricated parts, are influenced by operation while drifting, which may produce conditions extremely adverse to correct lubrication. Soot and cinders may be unavoidably drawn into the cylinder from the smoke box, while the oils must still maintain lubrication.

The factors which influence the selection of locomotive steam valve or cylinder oils are as follows :—

1. Quality of steam in valve chest and cylinder which may be wet, saturated or superheated—in the latter case, the governing figure being the total temperature, i. e. the saturated steam temperature plus the degrees of superheat.

2. Method of application, which may be by hydrostatic or mechanical lubricator to one or more of the following points :—

   (a) Steam pipe above valve chamber.
   (b) Valve chamber.
   (c) Upper part of cylinder wall.
   (d) Lower part of cylinder wall.

3. Service—long run road service, or suburban service or shifting service.

Diameter of cylinder is also a factor influencing the distribution of oil, and the quantity of oil required.

MAIN STEAM VALVES AND CYLINDERS

Speed and load are extremely variable. While in some classes of service a high speed may be maintained over a long run, the load may at the same time vary from maximum at starting and on an upward to no load on a downward grade and while slowing for a stop. Speed and load variations have a strong modifying influence on steam quality from time to time.

Steam quality—wet, dry or superheated—is a factor which influences the choice of the oil for valve and cylinder lubrication. So long as the degree of superheat is not extreme, there are always times where there is a condensation in the steam cylinders resulting from light loads and the automatic cut-out of the superheater by the action of the damper during certain conditions of operation or stopping. Even when a high degree of superheat is used, the variable operating conditions will at times result in condensation in the cylinders. With high superheat, and long continuous runs, however, there may be justification for the use of an oil of a body heavier than would otherwise be used.

There are two classes of lubricators employed for the introduction of valve or cylinder oil to the internal parts of a steam locomotive, namely, (1) the hydrostatic lubricator, (2) the mechanical force feed lubricator. Both types of lubricators give excellent service and the choice between them is often difficult.

The hydrostatic lubricator is located in the cab of the locomotive, and is at all times in view and under the control of the engine men. The operation of the lubricator depends upon the oil within the lubricator being displaced by water condensed from steam, which is admitted by a pipe leading from the boiler. The flow of oil is controlled by the adjustment of needle valves.

When a mechanical force feed lubricator is used, it is located near the locomotive cylinders, and consists of an oil reservoir, with several diminutive, positive-acting plunger pumps, which are mechanically operated by a mechanism operated from some moving part of the engine. The plunger pumps are so designed that the quantity of oil discharged can be regulated. After adjustment, this type of lubricator requires no further attention than filling.

It should be observed that the hydrostatic lubricator feeds oil uniformly with respect to time, i. e., a constant number of drops per minute, and that, therefore, an engine running at high speed receives less oil per revolution than when running at relatively low speed, unless re-set by engine-man.

The mechanical force feed lubricator, on the other hand, may be made to feed oil at a constant rate with respect to the revolutions of the driving wheels, i. e., to feed one drop of oil for every so many strokes of the piston. Relatively speaking, this type of lubricator then supplies more oil when the engine is running at high speeds than does the hydrostatic lubricator. By driving the lubricator from a part of the valve gear that has a variable motion, the rate of feed may be made to vary accordingly.

Drifting operation that permits access of cinders from the smoke box to the cylinders is a condition that renders satisfactory lubrication exceedingly difficult. Oil is a binder of the impurities which can only be made more serious by the use of an oil of unusually heavy body. It is frequently the practice to keep the throttle slightly opened when the engine is drifting in order to provide steam to atomize the oil, also to avoid drawing in cinders from the smoke box.

The great majority of locomotive operating conditions call for the use of cylinder or valve oil, which has a body sufficiently light to assure atomization. Whenever extreme water conditions prevail, a compounded oil should be used. The compounding of this oil renders it a very adhesive lubricant, capable of maintaining a lubricating and sealing film in spite of moisture resulting from cylinder condensation and has long-lasting qualities.

The locomotives operating on long, continuous runs in which a heavy load predominates, the use of highly superheated steam sometimes calls for the use of an extra heavy bodied oil for which service Caltex 474 Mineral Superheat Valve Oil (G/0—101/33) is recommended, due to its high lubricating value, heavy body and special quality indicated in high temperature conditions.

STEAM REVERSING CYLINDERS

Steam cylinders of power reversing gears require but a small amount of cylinder oil to accomplish lubrication. The same Cylinder Oil as is used for main cylinders should be applied by means of the oil cups or other fittings provided for the purpose.

AIR CYLINDERS OF REVERSING GEAR

Where power reversing gear is operated by air cylinders, good lubrication and an effective piston seal can be maintained by the application in the shop of Caltex Petroleum Jelly by means of a compression cup or through the gland.

STEAM CYLINDERS OF STROKE ENGINES AND LOCOMOTIVE AIR PUMPS

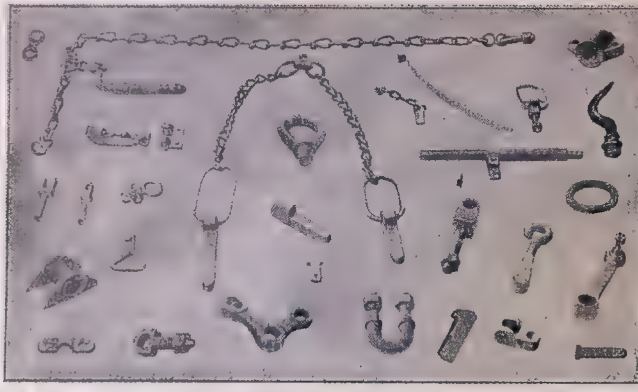
These steam cylinders are lubricated by feeds from a hydrostatic or force feed lubricator. The same Cylinder

(Continued on page 48)

Manufacture of Railway Iron Fittings in France

WHEN a foreign visitor comes to the French Ardennes having in view business transactions in Railway iron fittings what does he expect to find here but the usual scenery of an industrial country: chimney stads smoke black sky, a gloomy dark atmosphere.

He is ready to retrace his steps thinking that he took the wrong road when he finds himself in a beautiful greeny country, when he sees rivers and torrents winding their course amongst mountainous tracts. He, nevertheless, looks for the factories he has come to see, and suddenly he sees them, hidden in a scenery which surprises him and is, for his eyes, an unexpected enchantment.



Various Parts.

Various Parts.

Why is nature so intimately blended here with the industry? It is because, in the Ardennes, nature gave birth to industry.

A very long while ago, men discovered the need to manufacture iron implements. They found in our country both the ore and the fuel, this fuel was the trees of our forests, the ore was there, just by scratching

(Continued from page 47)

Oil should be used for this purpose as is applied to the steam cylinders of the locomotives.

AIR CYLINDERS OF LOCOMOTIVE AIR PUMPS

The temperature in these air pump cylinders resulting from air compression is high, requiring the use of a heavy bodied oil. It is recommended that the same Cylinder Oil be used here as is applied to main steam cylinders. Several types of special oil cups and air pump lubricators are employed for this purpose.

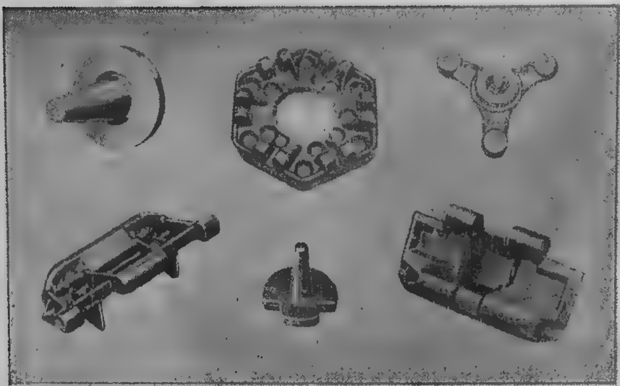
AIR BRAKE LUBRICANT

The lubrication of these cylinders requires a special lubricant which will stay inplace and maintain lubrication and piston seal from one shop inspection to the next. Caltex 904 Grease Graphite has been developed specially for this purpose and should be applied in the shop to the cylinder walls in a uniform thin coat by swabbing.

TRIPLE VALVES

The correct lubrication of triple valves requires care in application of the lubricant as well as its correct selection. There is a difference of opinion as to the relative desirability of a grease or an oil for this purpose. Where a grease is desired Caltex 904 Grease Graphite is recommended. The correct oil for this purpose is Caltex 754 Oil (G/o—101/44). These lubricants are adapted to resist the effects of low temperatures. In either case, the frictional surfaces should receive an extremely light application of the lubricant at the time of shop inspection. The use of either of these lubricants and the observance of the precaution regarding application will assure the free operation of the triple valve at all times and will guard against clogging any of the parts of openings.


COMPTOIR DES FERRURES
CHARLEVILLE (FRANCE)
THE
COMPTOIR DES FERRURES
MANUFACTURE ALL FORGINGS
AND STAMPINGS USED BY THE
INDIAN STATE RAILWAYS
Agents Messrs GAYTEE & C°
JANMABHOOMI CHAMBERS
FORT STREET, FORT BOMBAY
EST-NORD PUBLI CHARLEVILLE



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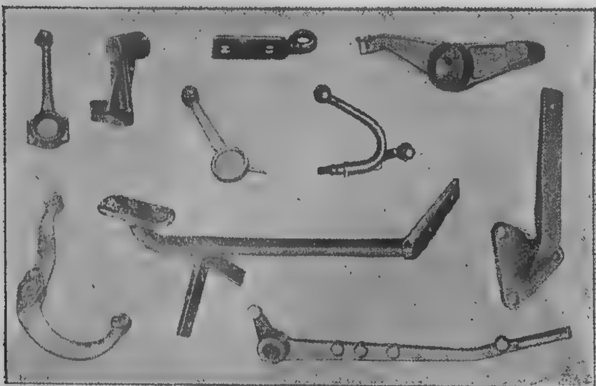
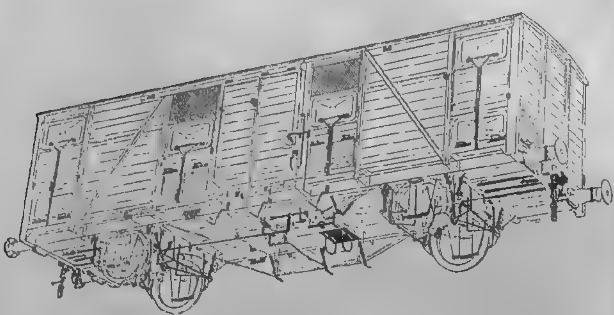


Various Parts.

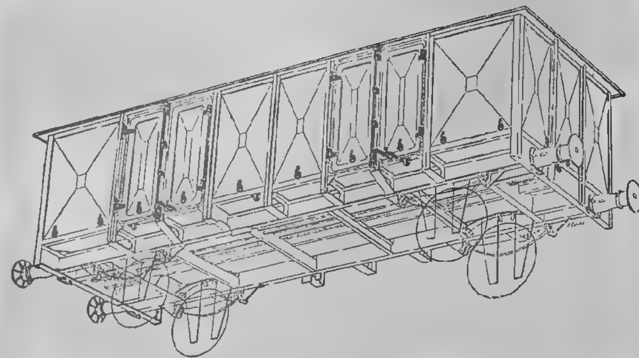


Iron parts for the manufacture of covered Railway Wagon.

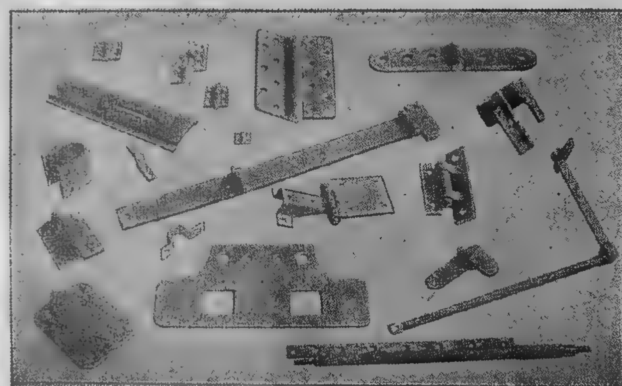
the ground, in the limited quantities sufficient for their needs.

Our iron industry was born then, and its continuous growth was due to the lucky fact that coal and iron mines were in the immediate vicinity.

The very first railways made use of the Ardennes'



Iron parts for the manufacture of open Railway Wagon.

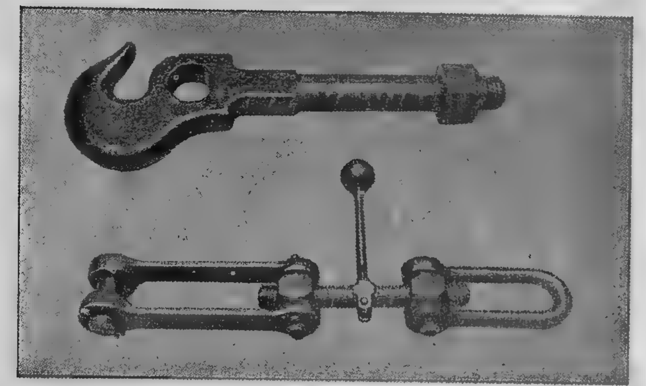


Hinges and Various Parts.

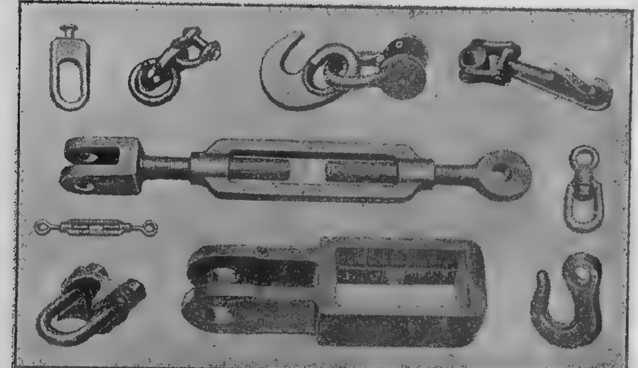
Locks and Various Parts.

iron forging and stamping industry for their fittings. Thus, being specialized in these forged fittings manufacture, the industry followed the growth of the railroads adapting itself to its ever increasing need.

This industry supplies all the French Railways' fittings and its exports towards foreign countries are increasing yearly.



Draw Hook, Screw Coupling.



Hooks and Various Parts.

The end of the last world war with the necessity of a total reconstruction of the French Railway system, demanded an ever increasing production. Individually our factories, which are small and medium size, were unable to answer to these enormous needs. But these needs had to be met and the only solution to this problem was the creation of the COMPTOIR DES FERRURES. This company studied a global working plan, and, specializing each plant in the manufacture of the kind of fittings best adapted to its possibilities, got the result it looked for: Heavier production, reduction of the manufacturing costs.

The COMPTOIR DES FERRURES associated factories employing more than 2000 workmen have been now organized for ten years and they deliver fittings to most of the whole world's railways.

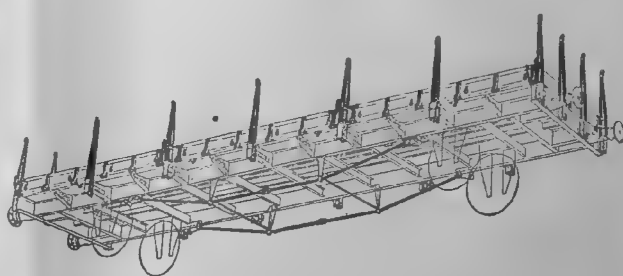
Amongst the COMPTOIR DES FERRURES Foreign Customers, India occupies the very first place. For Years, fittings used in the manufacture of MC, MOX, O, CR Wagons and carriages have been supplied by us and our workmen know them just as well as they know the fittings supplied to the French Railways (S. N. C. F.) Tens of thousands of pieces, from the cotter Pin (W20) of but a few ounces weight to the heavy and strong draw hooks (W445) have been made in our works. I. R. S. Inspecting Officers visit us almost weekly and their presence there does not surprise more than the calls of the French Railways Inspecting Agents.

By the use of a complete and modern range of forging hammer and presses and drop stamps, our equipment for heat treatment ensures for our customers a full guarantee of a manufacture fulfilling their requirements.

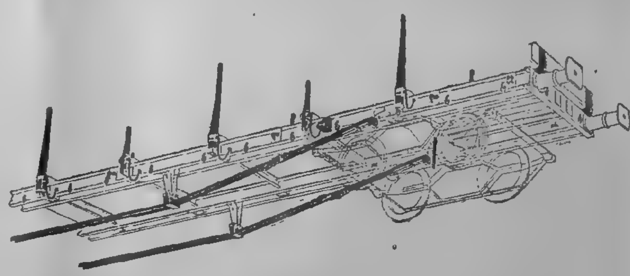
Our mechanical and chemical laboratories, equipped with the most modern apparatus are constantly checking the quality of the various steels. It is at the disposal of all Inspecting Officers for any test they wish to make.

As our factories are all specialized we are able to insure deliveries required by our customers. Large orders are shared among several works in order to avoid any shipping delays even in the case of difficulties in one particular factory.

The COMPTOIR DES FERRURES keeps a complete watch over the manufacture and it is its duty to see that promised deliveries are made in due time.



Iron parts for the manufacture of Flat Railway Wagon.



Iron parts for the manufacture of "RORYW" Wagon.

(Continued on page 52)

Range of Armstrong Whitworth Pneumatic Tools for Railway Workshops

TO compile a list of tools for use in Locomotive, Carriage and Wagon Works would mean quoting almost every tool in the new Armstrong Whitworth No. 53 Industrial Catalogue, as there is not a tool in the Industrial range for which a suitable "Railway" application could not be found.

Removing Stay Bolt rivets from Loco. Fire Box with Armstrong Whitworth Size 9300 Rivet Boster.

Armstrong Whitworth's experience in the design and manufacture of portable power tools ensures that each tool is built to the highest standards of engineering precision. The arduous conditions found in the Railway industries to which these tools have been supplied, have proved them to be robust in construction and trouble free in operation.

Armstrong Whitworth manufacture a complete range of reversible and non-reversible rotary air drills, from the 362 series with a capacity of 29/32" and 1", up to the 363 series with a capacity of 1¼" 1½" and 2". These drills can be used for drilling, reaming and tapping, or adapted for tube expanding and flue rolling. Also in this range is the 362 series woodborers, which have capacities up to 4". Tools of practical necessity in the construction and maintenance of the permanent way.

The Armstrong Whitworth Size 3RDC/35 Panel Saw is specifically designed and manufactured for repair work on Railway coaches, such as cutting out for

Cleaning up a weld after a repair job on a Locomotive Frame with an Armstrong Whitworth Size 246 Grinder.

(Continued from page 51)

The COMPTOIR DES FERRURES makes forgings and stampings for all the rolling stock made in Europe for, India (France, Belgium, Austria, Holland, England.) We feel sure that our knowledge of the Indian market in these lines and our producing capacities will enable us to become a supplier of the Indian States Railways. We shall always be happy to study and answer all inquiries.

Our works manufacture also all stampings, forgings and ironwork used in various industries (mines, marine work, motorcars) and in particular galvanized or nongalvanized pieces used in Railways electrification and in the telegraphic and telephone services.

Drilling holes for Chair Screws with an Armstrong Whitworth Woodborer Size 362 RHW.

Stay Bolt riveting in a Locomotive Fire Box with Armstrong Whitworth Size 406 Riveting Hammers.

patchrepairing panels in sheet metal, when they have become badly rusted. This tool is an ideal tool for fast accurate sawing of light timber, it has a $2\frac{1}{2}''$ diameter blade, is extremely powerful, and has a fixed Dead Handle for accurate manoeuvrability, whilst being perfectly safe by the provision of a fixed guard. Armstrong Whitworth also manufacture a complete range of Rotary Air Impact Wrenches which have capabilities for nutsetting up to $1\frac{1}{4}''$ capacity bolt diameter, and can be effectively used with available attachments for screwdriving, tapping, drilling, grinding, wire brushing, and sanding. The Sizes 48 HG and 80 Impact Wrenches are particularly suitable for heavy duty work, such as the removal or running down of nuts with bolt diameter up to $1\frac{1}{4}''$.

The 5V Series Grinders are ideal tools for use in Locomotive works for the grinding of horn cheeks. Their rugged construction and tremendous power make these tools first choice for cup wheel grinding. Their design includes a built in muffler which reduces the sound level to 1/6 of that of similar machines.

Armstrong Whitworth manufacture a complete range of Riveting Hammers which are ideal tools for Locomotive works, for applications such as stay bolt riveting. The light Riveting Hammers sizes 76, 79, 712, 46 and 417, have capacities up to $\frac{5}{8}''$ Hot Rivets, and the Size 83S Close Quarter Riveting Hammer has a capacity of $\frac{3}{4}''$ Hot Rivets. The range of long stroke Riveting Hammers covers Sizes 43, 53, 83 and 93, which have capacities up to $1\frac{1}{4}''$.

Another tool suitable for Locomotive work is the Armstrong Whitworth Rivet Buster. This tool is manufactured in two Sizes, 6300 and 9300, and can be used with a wide variety of Cutting Chisels and Knockout Punches.

RAIL CONCESSION TO CANCER PATIENTS

Travel concessions by rail announced recently for blind persons and T. B. patients are extended to cancer patients on similar terms with effect from July 1, 1957.

Cancer patients travelling alone for admission to or on discharge from hospital or an institute where cancer patients are treated will be allowed to travel on payment of only one-fourth of the normal fare. When accompanied by an attendant, the patient and the attendant will be allowed to travel on payment of only one single journey fare.

The concession, which applies to the first, second and third classes, will be allowed only on production of the necessary certificate from the incharge of the hospital or institute concerned to the effect that the applicant is a *bona fide* cancer patient travelling for admission to or on discharge from a hospital or institute.


LOCOMOTIVES
SINCE 1869
WIENER LOKOMOTIVFABRIK
AKTIENGESELLSCHAFT
WIEN XXI. AUSTRIA

Austrian Federal Railways Electric Locomotive for Light-weight Express Trains

IN Austria electric traction on main lines has commenced as early as 1911. Considerable developments took place during the periods of 1923 to 1934 and since 1945 and were supported by the richmess with hydro-power. Therefore electric current for the electrified railways chiefly is being supplied by hydro-power plants.

Changeover from steam to electric traction has reached an important stage now, since A. C. 15000 V/16 2/3 cyc. traction runs through from the swiss border in the west to the czechoslovakian border in the east, a total of 515 Miles. Several other main lines, running from Yogoslavia and Italy in the south via Austria to Germany in the north are also electrified. They are crossing the mountains of the alpes by long banks, employing very long grades of as much as 1 : 30 and 1 : 40 and a considerable number of bridges and tunnels, out of which the so-called Arlbergtunnel, covering 6½ Miles is the longest. There are electrified at the moment in total 1030 line-miles of Austrian Federal Railways, understood 28% of the total mileage, but carrying more than 45% of the total traffic capacity.

All electric rolling stock to serve on Austrian Federal Railways since the very beginning were manufactured in Austria itself. Now chiefly there are engaged BoBo-type locomotives of 80 t, 3200 HP to 3400 HP and 57—70 mph, CoCo-classes of 110 t, 5400 HP and 70 to 82 mph., shunters with 68 t, 1050 HP and 32 mph. and several classes of straight electric railcars. Full attention is paid also to the problem of 50 cyc. electrification and a BoBo-dual-frequency-locomotive of 2800 HP in use, operating at both 16 2/3 and 50 cyc. by means of straight transformer and AC-motor equipment. In total the electric stock of Austrian Federal Rys. comprises of 380 units.

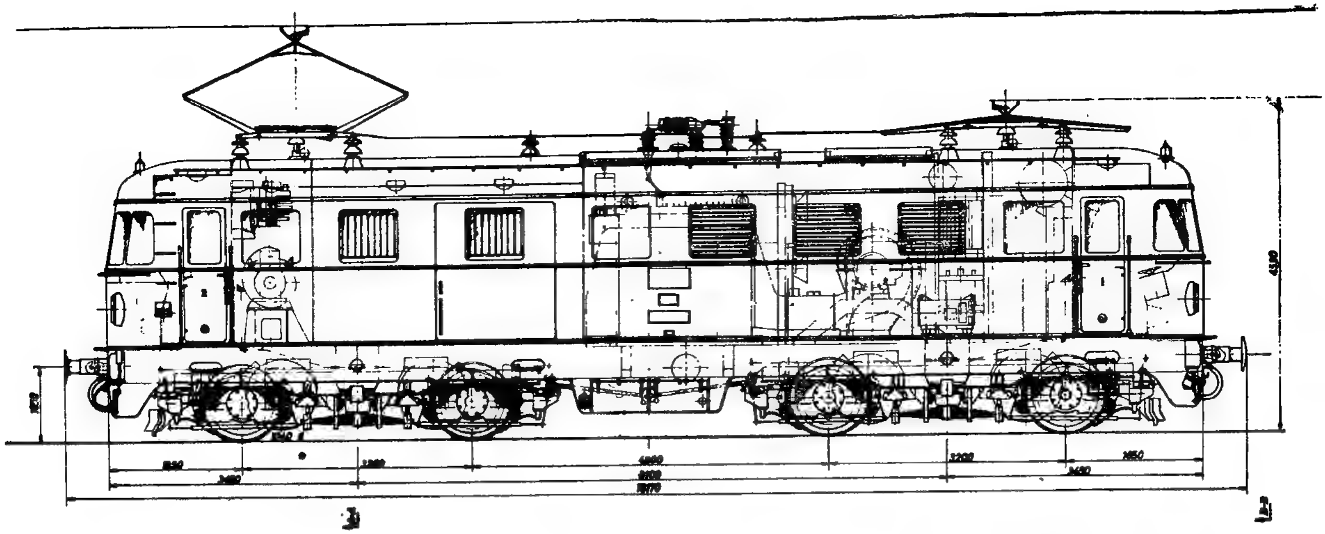
Now, to bridge a gap in traction requirements, the Rys. have brought out a new design of electric locomotive, having a luggage compartment, for hauling express trains formed of light-weight stock. The following progrmme has been adopted for operation scheme :

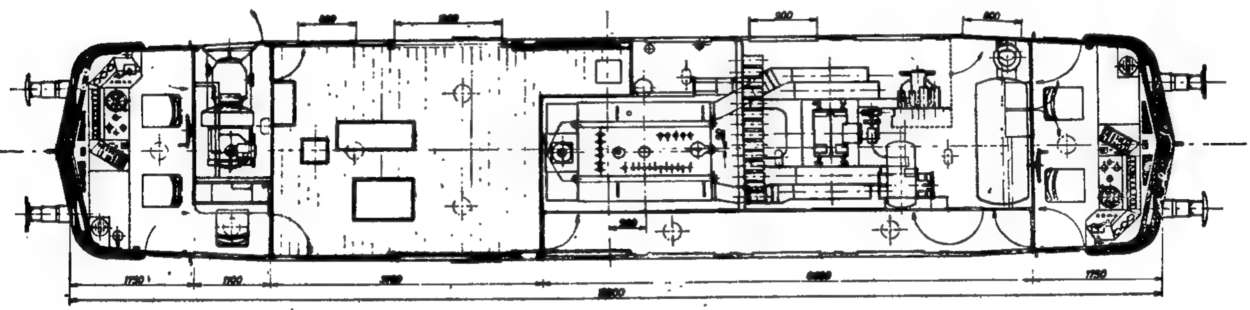
Hauling of train-tons with a speed of

gradient	57 mph.	63 mph.	75 mph.
0	960 t	720 t	350 t
1 : 100	290 t	230 t	120 t
1 : 50	170 t	150 t	

Under consideration of the relatively light-weight (29 t) of the carriages used with the said engine (the carriages are making provision for 80 passengers seating in 2nd class) trains of considerable capacity can be hauled on gradients also with reasonable speeds. As,

Austrian Federal Railways Electric Locomotive. (Class 4061)





in general, European railways use a separate van for luggage in locomotive-hauled trains, the adoption of this type of locomotive dispences with the need for this practice and allows an extra passenger coach to be added without increasing the train-weight.

The mechanical part generally follows conventional design but there are a number of new features. The bogie frames are of welded box sections. The wheelsets are driven by four fully suspended motors, the armature shafts of which are tubular, and the Secheron type flexible drive. Excellent riding qualities at high speed, the location of a reasonably sized luggage compartment, and a satisfactory lookout for the driver were important factors when the mechanical portion was designed. These requirements have been fully met, yet it has been possible to include a luggage compartment of nearly 12 sq. m. and keep the loading almost constant on all axles.

The bogie frames are fabricated by welding, the box section being constructed from folded section channels, made from pressed plates, on the top and flat plates on the bottom side. The centre cross-member carries the traction motor suspension at the side of pivot. The method of housing the bogie pivot, which is connected to the bogie through the medium of a spherical bronze bushing encased in a sliding block is combining simple design with minimum wear.

The axle journals are carried in boxes, having tubular guides. Silentbloc bushings are employed with the guides and in addition to the helical springs friction dampers are provided. The bearings are of SKF self-aligning roller bearing type. The hollow bored axles carry cast steel spoked centres pressed on. Since the Secheron-Lamella axle drive employs a gear on one side only, one centre of each wheelset has an integral face for fitting the straight spur gear wheel.

Traction and brake loads are transmitted from the bogie frame to the bolster via manganese steel liners with very small clearance. Suspension is by under-hanging laminated springs and transmission of weight is effected by means of shackles, hung from rubber shock-absorbers which are connected to the bogie-frame. For smooth riding and to decrease flange wear, the bogies are coupled by a spring-loaded coupling, but as the traction and brake loads are transmitted via the bolster to the underframe, this arrangement is not affected by such loads.

The underframe, of fully welded construction, is composed of tubular members of more or less rectangular shape on either side. Light fabricated cross-members, headstocks and u-shaped girders are welded to the side members, which are also employed for ducting air from the blower fans to the traction motors. A 4 mm. (5/32 in.) plate covers the top surface of the underframe.

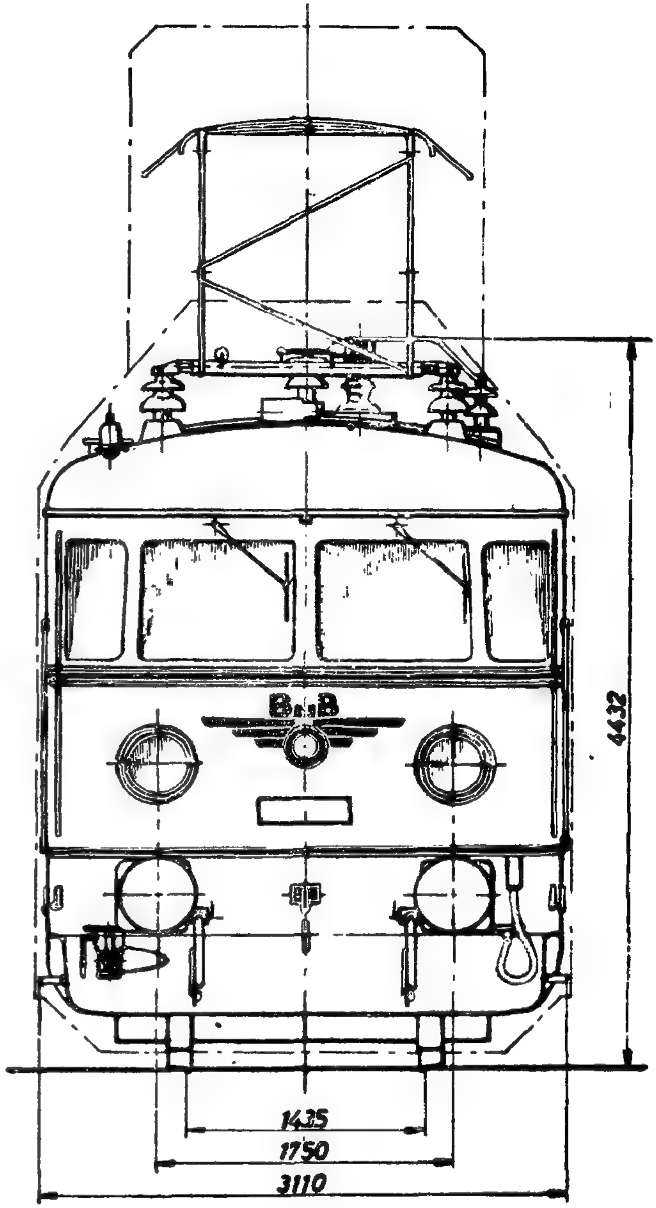
As will be noted from the illustrations, shields are provided. The bogies are protected against snow and dust, and all tool and battery boxes below the side members of the underframe are also furnished with radiussed shields.

The superstructure is also fully welded and is built-up from light-weight rolled angles and cold-bent u-channels, with side walls and roof sheeting of 2 mm. (14 SWG) mild steel plates, tack welded to the structure. Two openings in the roof give access to the electric equipment for lifting. Both the pantographs and all H. T. insulators on the roof are attached to the fixed portion of roof.

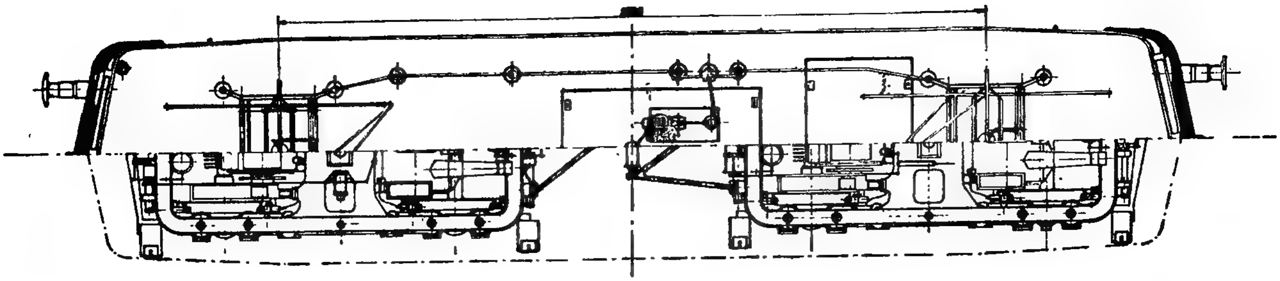
The mechanical braking arrangements are separate for each axle, clasp shoes being used. The arrangement saves much weight compared with that previously used and permits excellent tax access for inspection of traction motors, axle-drives etc. One 10 in. brake cylinder per axle is fitted. Compressed air is supplied by a compressor located in a separate cabinet. Air in the main reservoirs is kept at a primary pressure of 9 atms. An axle-driven brake power adjustor gives a brake efficiency of 73 per cent for speeds of 60 km./hr. or less, and 144 per cent of the engine weight when running at more than 60 km./hr.

Mechanical lubrication is used for the bolster slides, bogie pivot bearings, brakeshaft bushings and bushes of the bogie springloaded connections. Bearings of axles and motor shafts are grease lubricated. Speedometers are provided for both the cabs. Lay-out of equipment inside the cabs to operate the engine is arranged for working of crew in sitting position. A dead-men device is provided also.

So far design of electrical equipment is concerned it has been governed by the two requirements of not exceeding a weight of 28 tons and of using as many parts as possible which are common to other electric locomotives of the Austrian Federal Railways. For the moderate power range required, low-tension control with electro-pneumatic contractors and three preventive coils was found suitable. The voltage increments between the early notches are small, in the interests of adhesion and a high accelerating rate, but are increased on the higher positions of the controller. A unilateral drive has been used in order to minimise the space occupied by the traction motors and permit a low floor level as usual with luggage vans.



Ansicht B-B



Two light-weight, air-operated pantographs of double-pan type are fitted, but only the trailing one is used in service. Current is fed to the transformer through roof mounted isolators and a air-blast circuit breaker.

The core-type transformer with windings of circular cross section, has ten secondary tappings giving a voltage range from 72V to 480V for the traction motors; also tappings at 800 and 1000V for train heating and a 208V tapping for the auxiliaries. The preventive coils are housed inside the transformer. Cooling oil is circulated by a pump and passes through radiator tubes which are forced-ventilated.

The traction motors have a 1-hr. rating of 550 h. p. at 1250 A. Shunts consisting of an inductive and a non-inductive resistance in parallel are connected across the intrepoles to improve commutation. Class B insulation is employed for the armature and the field windings. To accommodate the Secheron leaf-spring drive the armature of each traction motor is shrunk on to a hollow shaft running in roller bearings. A torsion shaft passes through the armature shaft, to which it is coupled at one end by one element of the spring drive. The second spring element couples the other end of the torsion shaft to the pinion in the gear case, which meshes with a gearwheel bolted to the wheel centre. The gearcase is axlehung at one end and is supported at the other end from the bogie frame by a linkage.

The operation of the 24V c. c. electropneumatic control contactors is supervised by a differential relay system which prevents incorrect connections from being established. Nineteen steps of voltage control are provided, of which the first two are used at starting only. Other protective relays comprise two in the high-voltage circuit, a no-current relay, and a heating relay. Instruments include ammeters, traction motor power consumption meter and a battery voltmeter. Lamp signals monitor the operation of the equipment when starting and confirming functioning of the blower fans and of transformer oil pump. Audible warning is given of before the dead mens device comes into action.

The initial order was placed with Wiener Lokomotivfabrik A. G. for design and manufacture of mechanical part and ELIN A. G. for design and manufacture of electric portion for twelve locomotives. They are now hauling light-weight trains over fairly long distances. They are shedded at Salzburg and undertake express service to Vienna (200 Miles). On some occasions they have easily hauled nine such coaches within the scheduled time in lieu of the expected six. The temperatures of transformer and traction motors on such occasions has been far below the calculated figures. A contract for 13 more of the class is being considered and is expected to be signed at an early date.

THE MAIN PARTICULARS

Horse-power at 1-hr. rating	2200 HP.
Equivalent speed	54 mph.
Horse-power at continuous rating	1950 HP.
Equivalent speed	60 mph.
Tractive effort when starting	12,0 t
Tractive effort at 1-hr. rating	6,5 t
Tractive effort at continuous rating	5,2 t
Wheel diameter	1040 mm. (3′—5″)
Weight of mech. part	39,5 t
Weight of electr. equipment	27,5 t
Capacity of luggage compartment	3,0 t
Service weight	70,0 t
Max. permissible speed in service	125 km./hr. (80 mph.)

Are Railroads getting the most out of their Materials Handling Equipment ?

By L. A. DePolis,

General Sales Manager, Industrial Truck Division, Clark Equipment Company.

GETTING the highest efficiency possible out of your mechanized materials handling equipment is basically a matter of good management. What are the major points to be considered in reaching this goal ? It isn't difficult to enumerate them :

1. Select the right equipment for the job.
2. Use the equipment properly. Don't ask it to do too much (or too little).
3. Make use of special attachments and other devices which will increase the usefulness of the equipment.
4. Insist on proper maintenance and service of handling equipment.
5. Know when the "point of no return" is reached. Replace old machines for new before heavy maintenance costs pile up.

SELECTING PROPER EQUIPMENT IS FIRST STEP

"Variety" is a one-word description of railroads handling equipment needs. Belt conveyors are necessary for receiving, classifying and manifesting freight as it arrives. Pallets are necessary for temporary storage of freight in holding areas. Pallet racks are necessary to assure best space utilization. Fork trucks are needed for pallet handling in freight terminals and in and out of freight cars. Trailers are needed to be used

81–1005—Series 81 Ross Carrier transports boxed-load of trash and rubbish to the dump at the main shops and general stores division of the Milwaukee R.R. Division of the Chicago, St. Paul, Milwaukee and Pacific R.R. in Milwaukee, Wisconsin.

with tractors or fork trucks for horizontal movement. Dollies and rollers may be needed for handling heavy machinery. Hand pallet and powered pallet trucks are needed for use inside freight cars.

Of all these the fork-lift truck is the most common piece of equipment used by railroads. Its mobility, liftability and ease of operation make it an essential machine for the variety of handling chores found at freight terminals. It is n't necessary here to go into the fine points of fork truck selection—capacity, width, upright heights, and so forth—since these requirements differ considerably from one installation to another. It is desirable, however, to mention two points which railroads may not be giving adequate consideration—the types of fork truck power available, and the use of special devices and attachments.

FOUR POWER TYPES AVAILABLE

Most fork truck manufacturers offer four types of power—gas, electric, diesel and liquified petroleum gas (LP-gas). Again, gas power needs no elaboration here; it is by far the most widely used, and its advantages are well understood.

Other types of fork truck power, however, may be well suited to certain handling operations. If fuel cost was the only factor involved, all fork trucks would probably be electric, for electric power is the cheapest available. The low-cost operation and longer life span of electric fork trucks usually off-set their higher initial cost.

Of equal importance, the operating characteristics of electrics offer unique advantages; they are quiet, clean, fume-free, and operate efficiently under extreme conditions of heat or cold. This latter feature could be of significance at terminals located in rigorous climates.

A variation of electric power is the "Ready-Power" unit. Ready-power is a gasoline or diesel engine powered direct-current generator adaptable to electric fork trucks. The unit is a completely self-contained packaged assembly, fully automatic after a push-button start, and is used instead of battery power where necessary. The motor generator unit is a source of ready power at all times, eliminating necessity of spare batteries, chargers and related accessories.

Where can electric fork trucks be used advantageously? Practice has shown that gas-power is more efficient for long-haul runs—carrying pallet loads from terminal storage to cars positioned several hundred yards away, for example. But not all operations are long-run. In short-haul moving of palletized freight inside the terminal or in loading trailers parked next to the terminal the economical operation of electrics pays off. An important point to remember is that electrics,

81–1006—Series 81 Ross Carrier transports bolster-load of steel pilings at the main shops and general stores division of the Milwaukee R. R. Division of the Chicago, St. Paul, Milwaukee and Pacific R. R. in Milwaukee, Wisconsin.

because of their fewer moving parts, require less maintenance than gas-powered trucks.

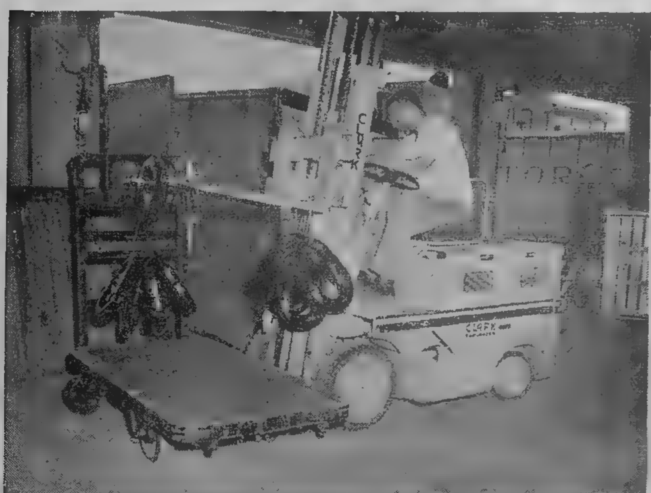
DIESEL POWER IS CHEAP

The principal argument for diesel power is its safety and low cost; although not as cheap as electric power, diesel fuel is less expensive than gasoline. And like gas-power, diesel is most effective for long outside runs.

THE NEWEST POWER TYPE—LP GAS

The newest development in fork truck power is liquified petroleum gas, or as it is commonly known, LP-Gas. In comparison to gasoline, LP-Gas has the advantages of lower fuel cost, less maintenance and longer engine life, and it does not produce harmful fumes. Originally designed for operation in areas where gas fumes would be undesirable, the economies of LP-Gas power have made it increasingly popular for many installations which normally would use gasoline.

In many instances where gasoline power is not desired, the choice lies between LP-Gas power and electric power. When this situation arises an important point to consider is that LP-Gas trucks have a greater degree of flexibility than electrics. Battery-operated electrics are more or less restricted to areas which have battery-charging stations, while LP-Gas trucks can be moved at will.



ECL–1544—Elec-Carloader removes anchor chain links from a trailer and deposits them on a platform truck for delivery to a box-car at Pennsylvania R.R. Butler Street Station in Philadelphia, Pa.

LP-Gas powered fork truck (and electrics), because of their fumeless operation, are especially suited for work around people in closed areas—in terminals or at luggage pick-up points, for example.

To summarize—it is probable, and properly so, that gas-powered fork trucks will remain as the backbone of freight handling equipment. Yet there are specific advantages in other types of fork truck power, and there are certain areas of materials handling in which these types can be advantageously employed. Determining the most efficient application is one step toward a more effective handling program.

AUTOMATIC SHIFT OR MANUAL SHIFT

A second point railroads may overlook is the desirability of specifying clutchless automatic drives for fork trucks. Most fork truck manufacturers offer some variation of automatic drive. Clark Equipment Company's Hydratork Drive, as an example, utilizes the principle of torque conversion.

Hydratork consists of two basic elements: a torque converter and a new type of fork truck transmission which eliminates the need for manual or automatic gear shifting. Power from the motor is automatically multiplied to meet changing power requirements—initial acceleration of a heavy load from a full stop, for instance, or for climbing grades.

Automatic drive offers several important advantages:

—Easy operation. This is important where untrained drivers must be used, or where many different drivers use the same machine;

—Lower maintenance costs. Elimination of clutch wear-and-tear saves considerably on service bills;

—Smooth acceleration prevents load damage due to jerky starts, and reduces possibility of damage from abrupt acceleration while loading freight;

—Greater controlled power for unusually heavy jobs.

Approximately the same advantages apply to fluid couplings used on towing tractors. This feature, available on some models, is standard equipment on Clark tractors. Use of a fluid coupling is especially advantageous when breaking away a heavy load from

standstill since it insures smooth application of full drawbar pull. The fluid coupling prevents loss of torque from the engine, thus permitting full engine power to be applied to the work. When the initial pull is completed and the load is in motion, drawbar pull drops to about half of the starting effort, permitting the fluid coupling to operate at a low temperature. With a fluid coupling the clutch is disengaged only when entering or changing gears.

The advantages of both automatic drive for fork trucks and fluid couplings for tractors should be considered when planning or replanning handling procedures. In most instances economies can be gained through their utilization. °

CAN FORK TRUCK ATTACHMENTS BE EFFECTIVELY UTILIZED?

Fork trucks are not only "fork" trucks. The list of attachments which can be substituted for forks is indeed a lengthy one. Clark alone manufactures more than 90 different handling devices. When unpalletized handling is desirable or necessary, special attachments can often be utilized. Several examples will illustrate this point:

—Machinery or other heavy, bulky items can be handled with a crane attachment quickly substituted for forks;

—Tires, wheels, round castings and items of similar shape can be carried and loaded with a ram attachment;

—Large cartons and bales are easily handled with any one of several clamp attachments;

—Use of paper pallets, with a Pul-Pac attachment for handling, can save an appreciable amount of valuable cargo space.

Don't forget that fork trucks need not be restricted to handling duties. With such attachments as sweepers or snow plows, they become utility trucks performing "extra" functions at little extra cost.

Consideration of fork truck attachments to increase machine utility is another step toward efficient utilization of handling equipment.

THOROUGH, CONTINUING MAINTENANCE IS ESSENTIAL

Above all else, the one activity which will increase the effectiveness of your materials handling fleet is the establishment of a thorough, consistent preventive maintenance program. The importance of this cannot be overstressed. Too frequently no consideration is given to preventive maintenance and the cause of machine failures. It is too common a practice to operate a vehicle until it breaks down and requires a major repair. If a little foresight had been used, a major repair would not have been necessary.

A rigid preventive maintenance program is a major step in securing from your materials handling equipment all of the service which was built into it. To paraphrase—an ounce of preventive maintenance is worth many pounds of major overhaul cure. In order to maintain handling operations at the highest efficiency and prolong the life of each vehicle, it is compulsory that preventive maintenance be performed regularly and systematically. This work should be done by qualified mechanics under competent supervision. A complete record of all service done should be maintained, as only through such records can a proper check be kept.

The time and effort required to maintain a preventive maintenance program is mandatory to reduce to a minimum the time lost while a vehicle is in a repair shop.

DRIVER TRAINING REDUCES MAINTENANCE

Since a major cause of equipment breakdown is careless operation, a logical supplement to sound

UT–1305—The Chicago, Rock Island and Pacific Railroad solved their wheel handling problem in the Chicago Shops by designing and building a special crane attachment for their Clark fork-lift truck, a gas-powered Utilitruc. The attachment is used to load and unload single and double wheels, to place them in storage or to take them from storage.

maintenance is an operator training program. Such a program is necessary for freight handlers on at least two counts:

(1) Rapid turnover of fork truck drivers and other equipment operators brings a more-or-less constant influx of inexperienced, untrained labor;

(2) Round-the-clock operation means that each machine is subjected to the varying driving habits of several operators.

Admittedly, these same reasons make it difficult to implement a thoroughly comprehensive training program, yet adequate training can be obtained with some simple, inexpensive techniques. Fork truck manufacturers will gladly furnish driver manuals, safety suggestions and illustrative material on proper fork truck operation. Educational movies can be obtained free. Equipment suppliers are always available to give talks and lectures, and will even assist in setting up "obstacle courses" on which new drivers can practice.

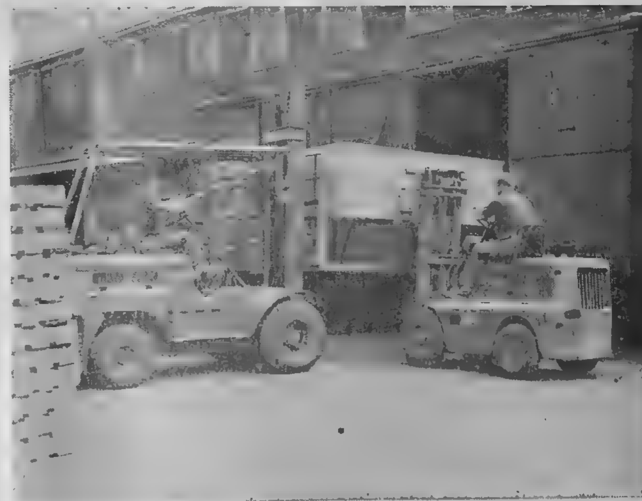
It is advisable that, like preventive maintenance, driver training programs be continuing. From time to time safety quizzes, driver tests and similar devices can be utilized in "refresher" courses, not only to keep operators alert, but to weed out incompetent operators.

WHEN TO TRADE IN OLD EQUIPMENT?

The procedures and programs discussed so far are designed to increase the utility and prolong the life of your materials handling equipment. But in spite of even the most tenacious adherence to these suggestions, the rugged daily wear-and-tear incurred by your machines eventually will raise maintenance and repair bills to the point where it becomes advisable to replace the machine. When is this point reached?

Speaking generally, a gas-powered fork truck will perform efficiently under normally heavy conditions for a period of five to seven years. Electric-powered trucks will last from seven to nine years. It must be understood however, that these figures represent a general average, and that wide deviations from this "normal expectancy" are common. Many electric trucks, for example, are still performing capably after 15 years of hard service.

It is not the age but the maintenance record and general condition of a fork truck—or any other piece of handling equipment—that determines its further



YL-4-1425—Two Clark Yardlift-40 unload plywood to a position where one may handle it from box car at Coutu Lumber Co., West Warick, Rhode Island.

usefulness. And these factors will always vary with individual trucks. As a general rule-of-thumb, however, the following pattern can be established:

Sometime between the second and fourth year of operation, a gas-powered fork truck will need a thorough overhaul. Two or three years later, a second overhaul will be required. It is at this point that an analysis should be made of the two factors cited above to determine the advisability of replacement. If the general condition of the machine is poor, and past maintenance records indicate that future repair bills will be high, then the machine should be replaced. If the opposite is true, then the expense of a second overhaul will be justified. Third overhauls are seldom advisable.

When a decision has been made to replace a machine, a thought should be given to the practicality of keeping the old machine as a "spare" rather than trading it in for a few hundred dollars. Semi-retired fork trucks need little or no maintenance, yet can be very useful for handling odd jobs, as extra equipment during peak periods, or as substitutes for machines tied up in the maintenance shop. Whether or not having a spare truck available for such emergencies is worth the sacrifice of a trade-in allowance will depend on the nature of the operation.

WHAT WILL TOMORROW BRING?

Obsolescence is a word well understood in the railroad industry. The most up-to-date equipment may

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New achievement of Hungarian Locomotive Manufacturing

12 YEARS after the second World-War the MAVAG Locomotive and Machine Factory being—with its past of 85 years of locomotive manufacturing—one of the most significant factors of the Hungarian Heavy Industry, reached a point signalling a further milestone, by manufacturing Steam Locomotives of YL class for the Indian Railways. The position is namely, that out of the 40 YL class Steam Locomotives ordered by the I. R. the Factory in manufacturing the 10th Locomotive produced the 2000th steam locomotive made since 1945, as a result of high rate production increase after the second World-War.

Two thousand......impressive even as a number, especially when we consider the locomotive manufacturing pace right before the war. Thus, at this occasion it would not be uninteresting to have a short reminiscence on the results of the Hungarian locomotive manufacturing which took its start in the year of 1871, especially on the gigantic development achieved after the second World-War achieved in a new social system, while building socialism, by the collective of the MAVAG Locomotive and Machine Factory.

While the Hungarian Locomotive Manufacturing was based at its start on satisfying inland requirements only, the development of the Factory and production soon made it possible to accept orders from abroad besides satisfying domestic necessities. Thus, even in the past, MAVAG locomotives were rolling over the borders proving the abilities of Hungarian Heavy Industry and increasing its good reputation. Still, Hungarian steam locomotives were not shipped overseas before 1945. The MAVAG Locomotive and Machine Factory besides satisfying the need of the MAV (Hungarian Railways) is producing mostly for export.

The dynamic development of Hungarian Locomotive Manufacturing is proved by the fact that in 1896, at the Millenary Exhibition in Budapest the Factory was able to introduce its 1000th locomotive. This locomotive with her serial Factory number 1000 was a four cylinder compound engine, with wheel arrangement

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(Continued from page 63)

become obsolete almost overnight as new designs and new theories become known. The same thing can happen in the materials handling field, and good management demands that new methods be examined and tried when higher efficiency can be obtained.

Two new materials handling techniques that have potentialities for railroad handling are the use of straddle carriers for fast horizontal movement of goods, and the "Mobilvan" system recently announced by Clark Equipment Company.

Originally designed for carrying lumber, the high-bodied, spidery-looking straddle carrier is now receiving industry-wide recognition as a highly efficient, low-cost means of transporting materials horizontally. With one man as operator, the carrier can load itself in five seconds, unload in three seconds, carry a payload of 50,000 lbs. and almost any length, and travel over the road at speeds up to 56 miles per hour.

These performance characteristics can be utilized in railroad handling at several points. As a substitute for tractor-trains, a carrier can pick up palletized freight in terminal storage and in a few moments deliver it alongside freight cars or trailers for loading. The carrier can be used to transfer freight (or maintenance supplies, parts and other materials) from one storage area to another—moving in a few minutes from one end to the other of even the largest Terminal.

MOBILVAN

The Clark Mobilvan System is based on the use of a lightweight van measuring 17′×8′×8′ and having a capacity of 20,000 lbs. Automatic locking devices enable it to be fastened securely to the bed of a railroad flatcar or the body of a flatbed highway truck. The van is moved by fork truck or straddle carrier.

Merchandise is loaded into the van at a shippers' loading dock and the van is transferred to a flatcar or flatbed trailer for transport to its destination. Here the van is transferred to the dock and emptied at the convenience of the receiver. An important advantage of the Mobilvan is that, unlike a conventional highway trailer, it can be used for storage indefinitely.

LOCOMOTIVES ARRIVE FROM HUNGARY

This is one of the four YL type steam locomotives arrived recently from Hungary out of an order for 40, placed by the Indian Railway Board with NIKEX, Hungarian Heavy Industries Foreign Trade Company and manufactured by MAVAG Locomotive Works, Budapest. Hungary has won international reputation not only in steam, but also in electrical and diesel traction locomotives.

4—4—0 and 2 m. coupled driving wheels, operated as MAV No. 222.068 and recognised at that time as one of the most rapid train locomotives of the highest output in Europe. The 4000th steam locomotive of the Factory was made in 1917, also for the MAV. This great Mallett system mountain-track locomotive with its (0—6—0) + (0—6—0) wheel arrangement—numerous locomotives of this type are still in service—was at that time the biggest steam locomotive with tender not only of the MAV but of Europe too.

It is worth to mention also the 5000th steam locomotive of the Factory made in 1932. This was a 122 type of the MAVAG, the first machines of which were manufactured in 1924 and which received the serial numbers starting with 424 at the MAV. This steam locomotive with tender, with its 4—8—0 wheel arrangement, a great number of which was and still is manufactured for the MAV, was also delivered recently to the Far East too, with a central buffer and drawbar arrangement.

As far as the type is concerned, though having been developed years ago, as a result of structural improvements and unifications during recent years, is still able to satisfy the most modern requirements and ever increasing production with an economic operation. Thus this locomotive type found a wide-range adaption not only at the MAV but at the railways of many other neighbouring countries too.

The Hungarian Locomotive Industry, since its producing capacity was even in the past surpassing domestic needs, was undertaking significant export deliveries. Besides locomotives it was shipping parts too for the neighbouring countries and also overseas. One of its biggest overseas shipment of this kind was also for the Indian Railways between 1928—1939 including 524 different locomotive boilers, numerous cylinders, coach running gears and other railway parts. During the deliveries of 11 years the customer was fully satisfied with the MAVAG productions and with this successful shipment the Factory reached a position among the prominent Factories even in worldwide respect. The MAVAG, besides locomotives of its own design, manufactures locomotives according to the drafts or prescriptions of foreign customers, in which case the Factory is willing to undertake designings too.

About the end of second World War air attacks caused serious damages as well in the workshops as in the equipment of the factory. Still, after the war having been finished, the Factory started the work immediately and after some months was running to its previous capacity. From then on a new development followed arching steeply upwards. Foreign enquiries for the Factory's products were permanently increasing. This rapid development was greatly promoted by the manufacturing of the wide gauge steam locomotives of the E. R. series with 0—10—0 wheel arrangement, produced from 1945, for the friendly Soviet Union. These locomotives more than 1300, were manufactured according to the technical prescriptions of the Soviet Union. Besides these wide gauge, big steam locomotives, narrow gauge steam locomotives with tender and with 0—8—0 wheel arrangement were also delivered by the Factory for the Soviet Union, always to the full satisfaction of the customer. Thus, in the year of 1950, the 6500th steam locomotive rolled out of the Factory.

To bear witness to the great development of Hungarian steam locomotive production with competitive unit prices, there are besides orders from the MAV, huge orders from the Soviet Union, oil fired locomotives ordered by the Egyptian Republic in 1950, and the recent order for 40 YL class steam locomotives with tender from the Indian Railways.

Especially great advantage rejoices the MAVAG by the fact that the modern test methods could be used in its own laboratories and that the creative activity of experienced engineers of its Designing and Construction Department, arm in arm with the workers, is leading the Hungarian Locomotive Manufacturing in a spirit of constant progress and development towards ever renewing successes. Relying on this co-operation has got the MAVAG from the start on got into the row of leading locomotive factories. About this work displaying great developments I wish to mention only that, that in 1951, for the MAV a new steam locomotive with tender for express trains has also been completed which, with its great dimensions and achievements, is able to compete with all the modern foreign— made steam locomotives of similar type. Steam locomotives for express trains of 4—6—4 wheel arrangement and 120 km/hour speed, are furnished with mechanical stokers and have been built on the basis of wide range railway experiences and modern designing and manufacturing principles.

It has to be mentioned that besides wide, normal and narrow gauge steam locomotives, electric, Diesel electric and Diesel hydraulic locomotives are also featured in the rich production program of the Factory. Thus, a great number of 600 HP Diesel electric locomotives with Bo—Bo wheel arrangement is under construction for the MAV and the Soviet Union and beside these 400 HP Diesel hydraulic locomotives for

the Egyptian Republic's Railways and for the Industry are also under construction.

Finally, we have to remember of the 2000th steam locomotive made since 1945, at the MAVAG as mentioned already in our introduction, which was the tenth of the 40 YL class steam locomotives manufactured for the Indian Railways. Although the space available here does not allow to give full account of locomotive manufacturing, we still have to give you a description of the main characteristics of locomotives and some data about their shipping. We also let you have a photograph of the steam locomotive with tender 1 m. gauge, with 2—6—2 wheel arrangement, being under manufacturing at the MAVAG.

MAIN DATA

Locomotive :

Cylinder diameter	12 1/4 in.	(311.16 mm.)
Piston stroke	22 in.	(558.82 mm.)
Coupled wheel diameter	3 ft. 7 in.	(1092.24 mm.)
Boiler pressure	210 lb./square in.	(14.75 kg/cm^2)
Heating surface	519.3 square ft.	(48.24 m^2)
Grate area	17.75 square ft.	(1.65 m^2)
Tractive force based on 85% m. e. p.	13000 lb.	(5850 kg.)
Weight in working order	39 tons	(39.6 t)
Maximum weight on axle	8 tons 2 cwt	(8. 23 t)

Tender :

Weight, fully loaded	33 tons 15 cwt	(34.29 t)
Weight, unloaded	16 tons 4 cwt	(16.46 t)
Water capacity	3000 gallons	(13.62m^3)
Coal capacity	4 tons	(4.64 t)
Total length between locomotive and tender buffers	53 ft. 9 1/2 in.	(16.396 mm.)

The locomotives are provided with hydrostatic central lubrication, vacuum brake system and electric light. SKF roller bearings are on both locomotive—and

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LOCOPULSOR SHUNTING MACHINE

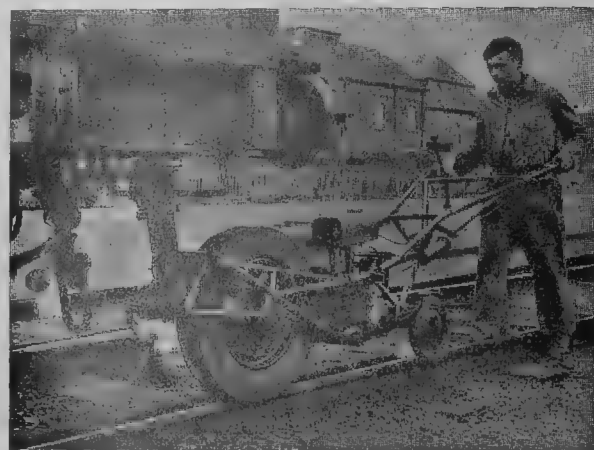
By An Engineering Correspondent

MOST Railway and works engineers will by now be familiar with the device known as the Locopulsor Shunting Machine which is manufactured by E. G. Steele & Co., Ltd., 93, West George Street, Glasgow, C. 2., Scotland, and is used for the shunting of railway wagons in works sidings and elsewhere.

The Locopulsor has found acceptance all over the world and there are now almost 2,000 of these machines in regular daily use in various parts of the world and the manufacturers are constantly on the alert to incorporate any devices which will increase the efficiency of their machine.

The recent development has been the production of a simple device known as the Auto-Pilot which is designed to facilitate the work of the operator in the operation of the machine as the Auto-Pilot automatically maintains the Locopulsor on the rail by guiding the driving wheel.

This device consists of a simple shoe which slips over the rail, as shown in the photograph, and is



practically 100% effective in guiding the machine on the rail.

The Auto-Pilot was actually developed to meet the needs of one of the Railway systems in Europe who had to manoeuvre Electric Locomotives during the course of repairs and it was necessary to construct the device which would allow the Locopulsor to be operated

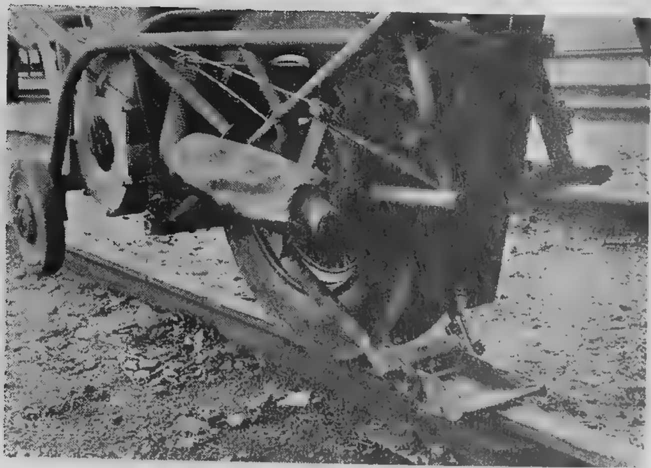
(Continued from page 67)

tender axles. The tender, in contrast with earlier types, is a new construction with four axles and two bogies. The shipment of the locomotives to India takes place from the Yougoslavian port Rijeka. Locomotives and tenders are shipped by the Factory on railway cars with dismounted wheel pairs to the port, where they are mounted before discharging. Thus, on arrival in India they can be put into operation without any particular preparation.

In this short report we intend to point out those newest results which are throwing a sharp light on the developments achieved by the Hungarian Locomotive Production, especially since 1945. Constant development of the Hungarian Locomotive Manufacturing made it possible that the Hungarian Locomotive Industry, besides the locomotives just manufactured and constructed partly for the Hungarian Railways, has considerable export possibilities and obligatory. Thus, the significant export activity of the Hungarian Locomotive Industry i. e. the MAVAG Locomotive and Machine Factory, is one of the most serious factors of the Hungarian Foreign Trade.

The Hungarian MAVAG locomotives become more and more well-known also at the Railway Companies of the overseas countries. The readiness of locomotive manufacturing is cheafly characterized by those locomotives we described above and the production (in small and big series) of which is proving at the same time fundamental fame in world relations. In consequence of the increasing demand of locomotives at home and abroad the Hungarian Locomotive Manufacturing is gaining an ever increasing reputation on foreign markets with its export and provides high esteem not only for the Hungarian Heavy Industry but for the MAVAG too.

We hope that by this short information we succeeded to gain new friends for the Hungarian Locomotive Production and to build up through Foreign Trade new connections also with the Railway Companies of the overseas countries.



automatically as there was danger to the operator in the live electric rails, but the more universal application of the device became quickly apparent.

The use of this Auto-Pilot is particularly indicated where a wagon has to be moved over a fairly long distance as the amount of effort required by the operator becomes virtually nil beyond walking beside the line of wagons. On the other hand the device is not suitable for short movements or where points and crossings have to be negotiated and when this type of operation is being carried out the auto-pilot shoe is removed from the rail by a simple cable control operated on the handlebars of the Locopulsor. The auto-pilot therefore, does not detract in any way from the manoeuverability of the Locopulsor and contributes appreciably to its universal applicability.

The device has been deliberately kept as simple as possible in order to reduce cost and also to keep the weight as low as practicable and can be fitted easily as an optional extra, even to existing machines.

A compressed-air brake for Diesel or Electric Railcars and Trailers

THE old-established French firm of brake manufacturers FREINS JOURDAIN MONNERET has developed, since 1934, a new air-brake system for railway motor-coaches, railcars and trailers. The chief feature of this brake system is the JMR class R distributing valve (patented S. G. D. G.), on which we can give the following data :

(a) It is *fully automatic* and works when a drop of pressure of 4, 3 lbs. p. s. i. occurs, for any reason, in the train pipe

(b) It is *moderable*, both on application and release, full release being obtained for a pressure of 71 lbs. p. s. i. in the train pipe.

(c) There is no fear of *exhausting* the brake, as the auxiliary reservoir is constantly fed during application.

(d) It is quite *safe*, as it works even for a slow pressure drop.

(e) Pressure in brake cylinders is independent of piston stroke and of possible leaks through piston packings.

(f) Cylinders can be operated under *high pressures*, as the pressure in cylinders can be higher than the pressure in the train pipe.

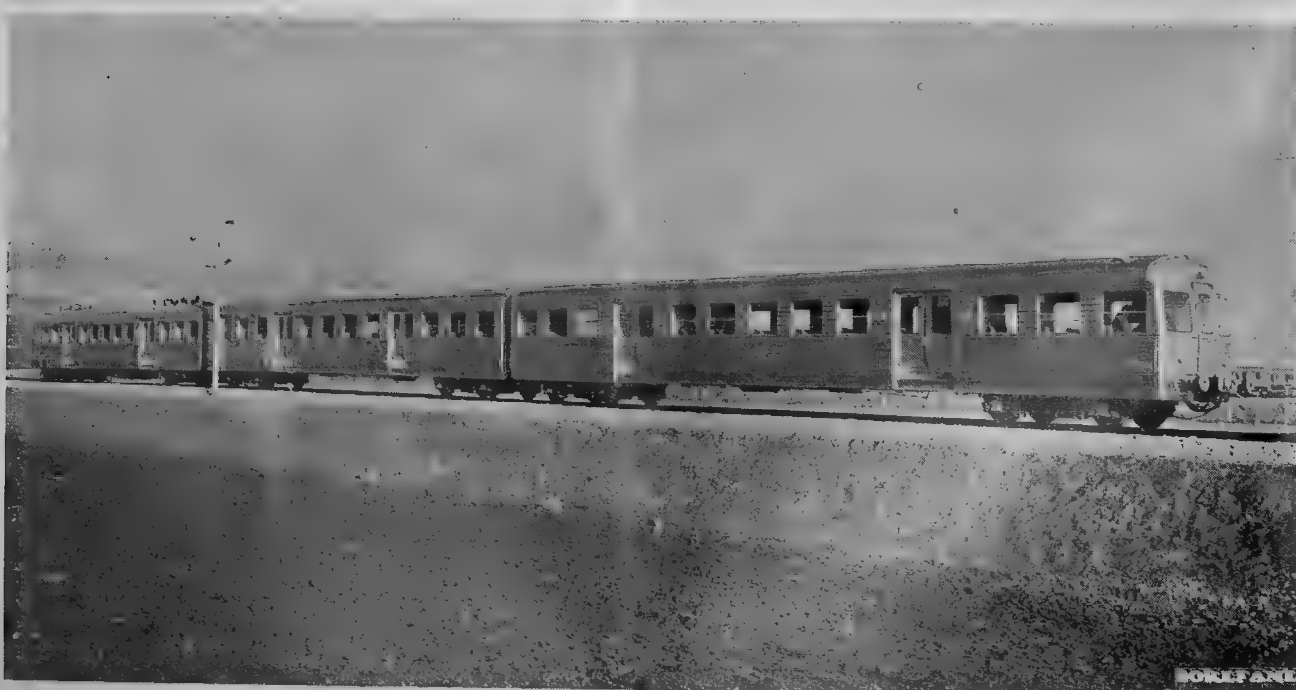
(g) It is *adjustable*. Cylinder pressure can be adjusted between 21.5 and 92 lbs. p. s. i.

(h) It can be fitted with a "dry track-wet track" device. This device is controlled by the driver through an electromagnetic valve and alters the pressure in brake cylinders.

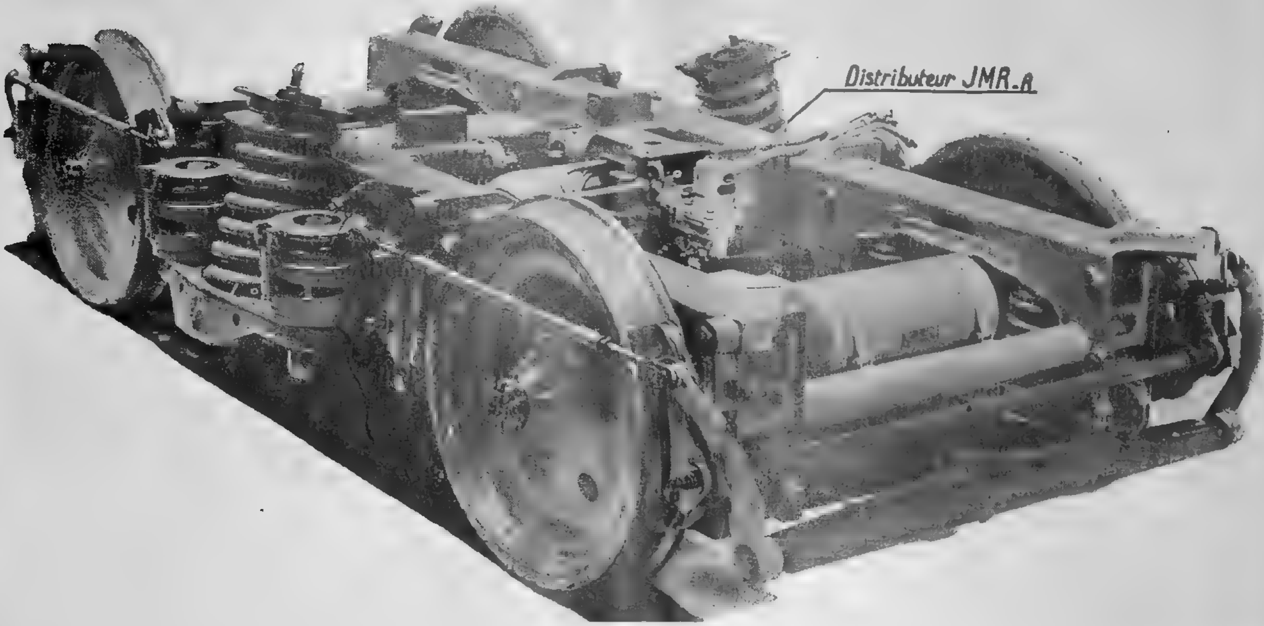
(i) It is *quick-acting*. On the first release, the rapid-acting device in the JMR—R distributing valve takes in a fair amount of air from the train pipe, resulting in a quick pressure drop.

(j) It can be fitted with an "empty-loaded" device which automatically adjusts the pressure in brake cylinders according to the load of vehicles.

FREINS JOURDAIN MONNERET have supplied thousands of these equipments to the French Railways, where they proved quite satisfactory in service.



"SOREFAME" units on the Lisbon-Cintra line Jourdain Monneret JMR–R Brakes.



Boggie equipped with Jourdain Monneret JMR-R Brake.

On the South-eastern district of the Paris suburban lines, on account of the increased traffic on peak hours, two, three, or even four double units are coupled to form a 8-car train, on which the JMR—R brake proves quite satisfactory.

The so-called " long-distance units " are also equipped with JMR—R and the " empty-loaded " device.

The new " Trans-Europe-Express " fast units have the same equipment.

Faster and more important units, such as used in Morocco, include seven vehicles (2 motor-coaches and 5 trailers—weight : 275 tons length : 500 ft.—max. speed : 87 m. p. h.)

The latter units are fitted with an extra quick-acting valve which brings a still quicker braking action.

FREINS JOURDAIN MONNERET have also designed a system of electric control for the brakes (patented S. G. D. G.) to obtain instantaneous braking action from one end of the train to the other, whatever be the number of cars.

Each JMR—R distributing valve is actuated through two electromagnetic valves (one for application, one for release) which are energized by contacts on the driver's brake valve. The system is quite safe, as, in case of failure of the electric supply, the brake reverts automatically to pneumatic control and retains all the above-mentioned features.

A section of JMR-R Distributing Valve.

The units now in use on the LISBON-CINTRA line (PORTUGAL) and built by Societe SOREFAME, are equipped with this system, which also embodies the " loaded-empty " device.

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Czechoslovak Diesel-Locomotives in the year 1957

By Ing. Ludvik Tejral

THE technical progress achieved by almost all branches of human activity has, until a short time ago, seemed to avoid the driving power applied for the railway traffic which remained an almost exclusive domain of steam as it was at the beginning of railways almost one and a half centuries ago. The area of application of the electric driving power, known for seventy years, remained considerably restricted. But in the last ten years the majority of railway administrations have been, during renewals and extensions of their locomotive stock, gradually abandoning the classical steam locomotive which had to give way to the modern locomotive driven by a Diesel-engine.

The Czechoslovak locomotive-building industry prepared itself for this elementary change which has no parallel in the history of railways. Based on its 30 years of experiences in the production of engine-driven carriages of the most different types, the Czechoslovak locomotive-building industry develops a type series of Diesel-locomotives of various types and dimensions. Until now the following four types have been put into service: A shunting light locomotive, driven by an electric motor, of the CKD type and the T 434.0 series, of an output of 700 HP. A traffic Diesel-electric locomotive for narrow-gauged lines of the CKD type and T 47.0 series, of an output of 350 HP. A CKD locotractor of the BN 150 type in different executions, with hydraulic and mechanic transmissions of the driving power. A CKD Diesel-hydraulic locomotive of the CN 400 type of an output of 400 HP.

The CKD Diesel-electric locomotive of the T 434.0 series is suitable for heavy shunting service in main railway stations, and in industry. In a traffic service this locomotive finds application in the manipulation of freight trains and for passenger trains of a capacity of 200 to 300 seats. The following are the main technical data of this locomotive.

Arrangement of axles	Bo Bo
Total service weight	63 t
Maximum operating speed	70 km./p. h.
Maximum tractive power on the circumference of wheels	14000 kg.
Gauge of wheels	1435 to 1676 mm.
Output of Diesel-engine	700 HP. for 720 n

The welded sheet framework supports bolted covers. Between the covers above the rear undercarriage is located the cab for the engine-driver. The removable type of the covers makes possible an assembly of the machines by means of a crane. The frames of the undercarriages have a box-type welded structure. The axles are fitted in roller bearings. The uneven load on axles during starting is automatically balanced, on one hand, by a mechanical leverage and, on the other hand, electrically, by an automatic shunting of the relieved driving motors. This arrangement makes possible a maximum exploitation of the adhesive weight of the locomotive.

In the cab are two posts for the driver, each of them on the right-hand side of the corresponding driving directions. Both posts are equipped with the driver's

(Continued from page 71)

The JMR—R brake is also fitted on numerous railcars now in service in SPAIN, GREECE, LUXEMBURG, WEST and EQUATORIAL AFRICA, TUNISIA, MADAGASCAR, etc.....

We can mention that the new railcar of the French Railways, with disc brakes, is also equipped with the JMR—R.

Concerning the French Railways, We can add that the famous French class BB and CC electric locos., which hold the world speed record (200 m. p. h.) were braked by FREINS JOURDAIN MONNERET.

FREINS JOURDAIN MONNERET have been brake specialists for the last sixty years. They manufacture all kinds of compressed air and vacuum brakes for rolling stock, steam, electric and Diesel locos., railcars, etc.....

Several thousands of waggons and cars for India, built in Europe, are fitted with automatic vacuum brakes manufactured by this firm.

panel with part of the control devices. The other control devices are located on the front wall in front of the panel. The sitting driver has during driving, all these devices in front of him, so arranged that the most important of them are immediately at hand. The devices in the three switchboards in the front wall of the cab, switch and check both the principal and the auxiliary circuits. The control devices—the controller and the reversing change-over switch—are coupled in both posts to enable the driver to change his post even during driving.

The eight-cylinder Diesel-engine, with cylinders arranged in line, of a special line design, is equipped with a number of protective mechanisms which secure safe operation and prevent damage to the Diesel-engine in the case of an accidental defect of the auxiliary devices. The generator, connected by flanges with the Diesel-engine, is sprung against the frame of the Diesel set. The generator carries an auxiliary installation consisting of an exciter for the generator, a lighting dynamo and a tachodynamo. From the extended end of the generator shaft the ventilator for the driving motors of the rear undercarriage is driven. In the front part of the cover are located water radiators, the ventilator for the driving motors of the front under-carriage and a brake compressor. The space of the rear cover is taken up by a tank for the automatic fuel oil heating, and a Diesel-engine with a compressor. The tank is dimensioned so that the produced steam is sufficient for heating the locomotive and five two-axle passenger-wagons. The engine compressor, the one cylinder of which works as a Diesel-engine and the other one as a double-stage compressor, serves exclusively for the preparation of starting air for the principal Diesel-engine.

The four-pole series-wound driving motors with a paw-type suspension have a separate ventilation. The controlling, lighting and auxiliary circuits are fed with a direct current of a voltage of 48 V from a battery charged by the lighting dynamo.

The locomotives of this type for a long period rendered good services on the lines of the Czechoslovak State Railways. In compliance with world development several prototypes of an improved type of these locomotives, marked T 435.0 series, are under construction. With the same Diesel-engine as well as electric equipment the output was increased from 700 to 750 HP and the weight of the locomotive was reduced. The air-starting system was replaced by the simpler electric starting system, and both the driver's cab and the covers are designed more suitably and, at the same time, have a nicer appearance. The contour of the locomotive was adapted to the profile of carriages for track gauges above 1000 mm.

The CKD Diesel-electric locomotive of the T 47.0 series is intended for track gauges of 750 to 1000 mm. The main technical data of the locomotive are as follows :

Arrangement of axles	BoBo
Service weight	32 t
Maximum tractive power	8000 kg
Gauge	750 to 1000 mm.
Output of Diesel-engine	350 HP for 1250 n

The side walls and the roof are attached to a welded frame-work. The whole forms an all-metal, self-supporting box of the wagon-type, with two driver's posts, a luggage compartment and a machine room. Part of the roof above the machine room is removable. The axles are fitted in roller bearings in the frames of the undercarriages made of welded sheet.

The post contains the driver's panel with all control devices. The engine-driver sits on the right-hand side in the driving direction. Near the left-hand window is located another lever of the controller, and the locomotive brakes making possible a safe control of the locomotive even for shunting.

The space of the machine room, considerably restricted by the width of the drive-through profile, is exploited to the maximum. The essential part of this space is occupied by a set consisting of the Diesel-engine and a generator. The CKD Diesel-engine of the 12 V 170 DR type is a water cooled, electrically started, twelve-cylinder engine. Many engines of this type rendered good services in various stationary sets, and more than a hundred engines of a traffic type also proved their worth in driving Diesel-engine cars of different series.

At the request of the Czechoslovak State Railways (which supplied the data according to which the locomotive was developed) a small luggage compartment with a table for the guard is located between the front post and the machine room. The compartment contains a permanent-heating stove for the hot water heating system which can be, in frosty weather, used also for heating the cooling system of a locomotive which is not is service.

The four-pole series-wound driving motors have separate ventilation. The generator is of a four-pole type with commutator poles.

The CKD locomotive of the T 47.0 series proved themselves fully in operation. The producing plant is working on a series of 40 locomotives of this type for export. Recently a further order from the Czechoslovak State Railways was received.

The CKD light Diesel-locomotive of the BN 150 type is intended, above all, as a replacement of the uneconomic steam locomotives. This locomotive will also do away with emergency shunting, for example, by means of tractors, motor trucks, winches or, on the track, by the locomotive of the manipulation freight train. The profile of the locomotive permits, after adjusting the wheel-pairs, its application on lines of a gauge from 900 mm. upwards. Even the possibility of application of various coupling rods and brake systems according to the specifications of foreign railway administrations is provided for.

The locomotive is driven by an air-cooled, Tatra 301 engine of motor car type, with a mechanical or hydraulical transmission of the driving power. Both types, the BN 150 M mechanical and the BN 150 H hydraulical, or otherwise almost identical. The tests of both the mechanical and the hydraulical prototypes lasted more than a year and were performed in the most different surroundings of industrial plants and railways. The successful result of these tests is proved by orders for more than a hundred locomotives of this type, which reached the makers during the testing period of the prototypes.

The CKD Diesel-hydraulic locomotive of the CN 400 type is intended for shunting in industrial plants and on railways where it can be very well used, for example, for service trains, for shunting on secondary railway junctions, for light freight trains of local lines, etc. An easy control and minimum maintenance are due to simple equipment. The engine is a CKD twelve-cylinder, 12 V 170 DR type, with a V-arrangement of cylinders, which has been used in railway traction for more than a hundred engine carriages of various types and on the T 47.0 locomotives The hydraulic transmission transfers the driving power of the engine through coupling rods on to the axles. The driver's cab located at the rear end of the locomotive is part of the cover. The driver's cab is provided with double controls, one set on each of the side walls. The mentioned types of locomotives have been tested by the makers, CKD Sokolovo, and can be delivered during the next year. Further prototypes, the traffic Diesel-electric locomotive, 1650 HP, and the Diesel-hydraulic locomotive, 400 HP, with propeller shafts and a central cab, will be put into a test service during this year, as well as the above mentioned prototype of a new variant of the Diesel-electric locomotive of 750 HP. Messrs. STROJEXPORT, Praha, Czechoslovakia, sole exporters of rail vehicles, which are made in Czechoslovakia, will gladly give all technical and commercial information about the offered and prepared types of the Czechoslovak Diesel-locomotives.

ALUMINIUM

According to the Chairman of the Yugoslov Foreign Trade Committee, construction of aluminium plant in Yugoslovia with the help of the Soviet Union and East Germany to which we referred earlier, is scheduled to be started next year. Output at this plant reportedly would be about 50,000 tons annually by 1961 and by 1965, output is expected to reach 1,00,000 tons. It may be mentioned that the agreement on the setting up of this aluminium smelter and other plants was signed in August last year.

It is observed from a published report that production of primary aluminium in the United States during the first seven months of this year totalled 966,285 short tons compared with 1,011,928 tons in the corresponding period last year.

In India, there is reported little fresh for aluminium from the market standpoint. Prices remained unchanged and demand ruled good, particularly in sheets.

* * *

PURCHASE OF RAILS FOR INDIAN RAILWAYS

The Union Railway Minister Mr. Jagjivan Ram is reported to have announced in the Parliament that the purchase mission recently sent abroad by the Railway Ministry for procurement of iron and steel has been successful to a great extent and "we are in a position to say that we will be able to implement the Second Five-Year Plan in respect of railway development". He added that orders have been placed for the purchase of 284,000 tons of rails as against the requirement of 291,000 tons upto the end of 1959.

Rolling Stock—An Industry of long standing in Rumania

THE setting up of a rolling stock industry in Rumania dates back to the year 1891 when the first freight car factory provided with a foundry of its own was put into operation.

As a result of our country's economic development, shortly after World War II all the requirements of the domestic railway network were being covered and a margin left for export purposes.

Today Rumania's export lists include various mass produced items in this sector whose excellent behaviour in service has been thoroughly checked Among these products are steam and electric locomotives, passenger cars and common and special purpose freight cars.

The Rumanian rolling stock works, which today turn out improved types of locomotives and carriages, have been equipped with high efficiency machines of home manufacture or imported, enabling them to carry out the entire manufacturing process.

At the "Gh. Dimitrov" works of Arad, for instance, a new plant has been put into service for case-hardened casting, centrifugal casting and casting in bakelite crust. Machined parts are made by means of the latest types of cam milling machines or copying lathes and forged parts through drop forging. The manufacture of small size parts has been fully automotized and their hardening mechanized. Automatic welding has been adopted in the manufacture of passenger cars. Plastics are being used to a much larger extent to replace metals while agglomerated wooden parts have superseded timber and plywood.

Assembly Shop at the "Gh. Dimitrov" Works in Arad.

50 m Tank-Car.

Lately the quality of the railway wagons has been improved through separate manufacture of sub-assemblies and the drying of paint by means of infra-red rays.

The same works have moreover been provided with a huge assembly shop—the biggest in this part of Europe—where 100 wagons can be assembled simultaneously. Another recent workshop is the boggie assembly shop fitted out with portal milling machines everyone of which is driven by 14 electrically operated motors.

Increased capacities have raised the output of these rolling stock works by 300 per cent in 1956 as against 1949, and the 1957 plan provides for a 400 per cent increase against 1949, this amounting to 80 per cent of the entire Rumanian production of rolling stock.

NEW TYPES OF LOCOMOTIVES AND WAGONS TURNED OUT IN THE RUMANIAN PEOPLE'S REPUBLIC

The number of types of locomotives and wagons of modern design turned out in Rumania is constantly increasing. In the category of high speed passenger train locomotives mention should be made of types *1 D2* and *2*CO. Both types are superheated steam locomotives with twin cylinders and tender. Their top speed is 110 and 100 km/h respectively. At an average speed of

Passenger Car.

60 km/h on a horizontal line they will pull trains of 1810 and 1230 tons respectively. In addition to the standard outfit for burning coal, facilities for burning fuel oil can also be provided.

Types *1ED* and *OEC* are two heavy locomotives of great power designed for goods traffic. These types are also superheated steam locomotives with twin cylinders and will pull 2600 and 3600 tons respectively. They have moreover a fairly high top speed for freight trains: 70—80 km/h. The equipment of these locomotives is in keeping with modern requirements and includes compressed air brakes, turbine for electric lighting, central greasing, train heating installation, closed driver cabin, etc.

Among the other items produced are also 50 ton covered freight trucks, tank cars for special fuel, 50 and 80 ton platform cars, 50 ton covered trucks for grain, 50 ton self-discharging trucks, 50 ton tank cars for petroleum products, 15 ton cooling cars, tipping cars, etc.

The Second Class Passenger Car with 9 compartments consists of a light metallic carcass which, together with the frame, forms a rigid tubular structure highly resistant and secure even in case of accidents. The bogies are of the Gorlitz type with soft suspension affording smooth and pleasant running. The brakes are of the automatic type combined with hand brakes. Two W. C. cabins are provided, one at each end of the car. The benches in the compartments are semi-upholstered with synthetic leather. The active lighting is by the Dick system; a wheel-driven generator and a voltage controller provide a uniform and bright light in the car. High quality timber—plywood and tegofilm—ensures durability and a pleasant aspect.

The Open Freight Truck on 4 Axles for 50 t effective load is a truck with high side walls on cast steel or pressed steel band bogies.

The fitted axle and springs are designed for a pressure of 20 tons per axle. The frame is completely welded. The design of the main beams is approximately that of a beam of uniform strength and allows the loads to be concentrated in the middle of the car, which thus becomes suitable for the transport of heavy and bulky machines.

The buffers, traction bearings and in general all the features of the truck are in keeping with the prescriptions of the International Railway Union. The automatic brake is of the Hildebrand-Knorr type; the hand brake is operated from a small platform located over the buffers.

The box of the truck is made of metal posts with wooden or full sheet metal side walls. The latter are removable, thus allowing the car to be changed into a platform. The stanchions, made of shaped sheet metal are also removable.

The 50 t Covered Freight Truck on 4 Axles has a completely welded frame. The H. K. brake is combined with a hand brake operated from a cabin. A passing through pipe makes it possible to couple these trucks to passenger cars. The box of this type of truck consists of metal posts and wooden side walls. The box has two sliding doors fitted with special fittings for complete or partial closing of the truck.

50 t Open Freight Truck on 4 Axles.

The eight ventilation shutters are provided with grates and collapsible support bars.

The truck may also serve to transport livestock. To this end the side walls are provided with rings for straps and with sliding partitions. For the transport of grain traps in the floor of the truck make semi-automatic unloading possible, while for the transport of passengers an opening for a stove chimney is provided in the roof and special supports for benches in the side walls. On the outside there is a ladder with handles.

All the above facilities are also part of the equipment of the 28 ton covered freight truck on two axles.

The 50 t Open Self-Discharging Freight Truck is of completely welded metal construction and will hold 70 m^3 of loose goods (coal, coke, ores, gravel, etc.) To this end the floor can be raised to form a saddle. When the lateral traps are opened the load is discharged without man's intervention. On the return journey the floor can be restored to a horizontal position and the truck used for the transport of machines, logs, etc. like any open truck.

The 50 m^3 Tank Car is of welded construction with frame and is designed for the transport of petroleum products. The tank proper has a diameter of 2.6 m, is 9.6 m long and is mounted directly on type Diamond bogies. The tank car has automatic compressed air brakes combined with hand brakes. A steam heating device is provided for lessening the viscosity of products when unloaded.

ENQUIRIES FOR ROLLING STOCK ABROAD

Today wagons of all types are becoming an ever more important Rumanian export item: 35 per cent of the wagon output is sent abroad. At the "Gh. Dimitrov" works of Arad alone the orders received from abroad have increased by 573 per cent in 1957 as against 1950, and the orders received in 1957 by the "23 August" works will represent an increase of 400 per cent as compared with 1950.

The manufacture of new types such as self-discharging trucks, full metal trucks, trucks on bogies, mail vans, railway trailers, motor coaches, etc. and the development of the rolling stock industry will make it possible to fill to an ever greater extent the substantial orders received from abroad.

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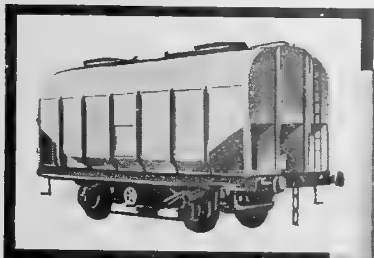
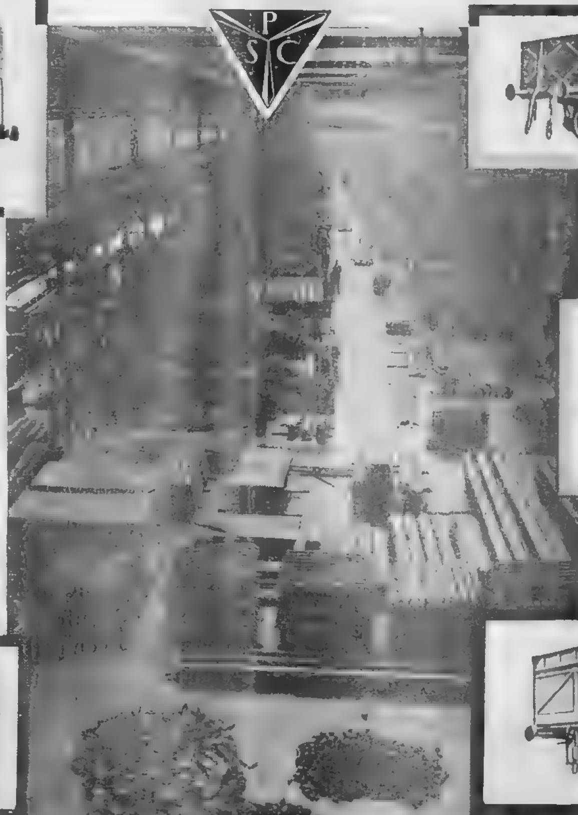
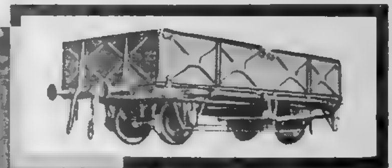
The strength of steel pays valuable dividends. In length of service. In fewer running repairs and maintenance. In longer operative life. In overall economy. From the Scottish factory of Pressed Steel Company Limited, steel wagons *many thousands strong* pass year by year to the railways of the world . . . for a hard *and long* life of service.



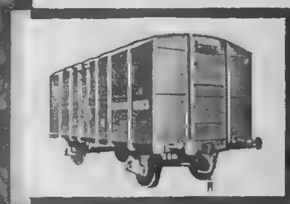
20-ton capacity Bulk Grain Van to the order of British Railways.



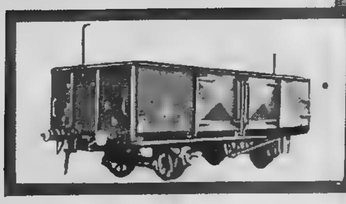


F.J.S. Low-sided Open type Wagon as used by Queensland Government Railways, Australia.

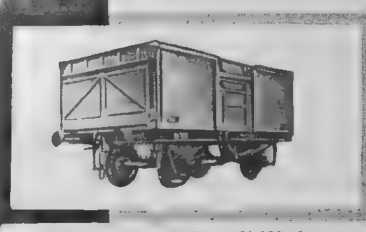
their service is world wide



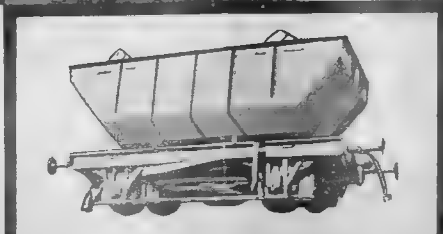
Broad gauge covered Wagon type C.R. as used by Indian Railways.



22-ton G.Y. type Wagon as used by Victoria Government Railways, Australia.



16-ton all steel Mineral Wagon, 50,000 of which have already been built in our Paisley works to the order of British Railways.



V. J. M. Hopper type Wagon with Drop Bottom Door as used by Queensland Government Railways, Australia.

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Power Cars for Indian Railways
All Air-Conditioned Trains

By A. C. Bhattacharya, A. M. I. Prod. E.

THE introduction of all air-conditioned trains on Indian Railways is a big step forward in travel comfort. They give experience that enriches life making the travelling public participate in a sort of railway rhapsody.

This is the first application in India of air-conditioning to a complete train including third class and restaurant cars and is a symbol of the progressive spirit of Indian Railways.

Each train is made up of two luggage, brake and Power Cars (one at either end), one first class sleeping car, one restaurant car and three third class chair cars making a total of seven coaches per rake.

The air-conditioning of an entire train requires large amounts of electric power and the principle of 'end-on' generation has been applied in this case. The arrangement supplies 400 volts, 50 cycles, 3 phase A. C. supply for the air-conditioning equipment and 110 volts, 50 cycles A. C. Supply for use in compartments for lights, fans, kitchen appliances, etc.

The generation and distribution of this electric power calls for highly specialised knowledge and new methods and equipments. The main equipment is housed in the luggage, brake and power car, six of which have already been constructed and two are still under construction in the Eastern Railway Workshops at Kanchrapara. The cars built are of entirely new design and are the first of their kinds ever constructed in Indian Railway Workshops.

The equipment has been supplied by J. Stone & Co., who were also responsible for the installation of the air-conditioning plant in all the coaches of these trains. The Power cars are, however, not air-conditioned.

The principal dimensions of the car is as follows:

Length over buffers	72 ft. 2 in.
Length over headstocks	68 ft.
Width over bodyside panels	10 ft. 8 in.
Gauge	5 ft. 6 in.
Tare weight with fuel oil	56 Tons.

Exterior view of the power car.

LAY OUT

The lay out incorporates two luggage compartments at one end with the fuel tank chamber in between and the power compartment on the other end to house the generating equipments, alternators, switch gears, etc. This end is vestibuled.

Location of the fuel tanks within a separate compartment between the luggage compartments was arranged to give the most even weight distribution on bogie loading and also to obviate any fire risk from hot pit ashes. As a further safeguard all wooden members underneath the coach that are exposed around this compartment have been covered up with aluminium sheets and painted with fire resisting paint.

In the centre of the vehicle is located the guard's compartment and a small compartment for the staff who will attend on the generating equipments. Attached to the staff compartment is also a lavatory for use of the staff.

A 2 in. partition across the power compartment divides it into two sections, one housing the engine units, radiators and auxiliary fuel tanks, while the other containing the alternators and electric switchgears. This arrangement enables filtered air to be drawn into the electrical section of the compartments by means of

the alternator fans and thus keeps that portion of the Power Compartment clean. Self-closing intercommunication door with transparent glass panels has been provided on the partition between the engine and alternator compartments. A chequered plate flooring has been fitted inside the power compartment centrally between the engines and also the alternators to provide the gangway leading to the vestibule.

The staff compartment has a 3-tier arrangements of berth, a table and a shelf. The lavatory has all fittings prescribed in the amenity standards for lower class coaches. The guard's compartment has similarly all accessories as are usually in vogue.

The bottom edges of the windows are located 2 ft. 6 in. from floor height and the window opening is 22 in. high. All window openings are 2 ft. wide. The shutters in these windows are the standard 'lift-to-open' type.

The Power compartment is fitted with body side aluminium louvred doors covered by wire mesh to allow a free exchange of air by normal ventilation. The sizes of these doors are comparatively larger to facilitate removal of the generating sets for servicing and repair. A work bench is placed inside this compartment. The engines and the alternators are positioned in the compartment in relation to the centre line of the bogie both longitudinally and transversely.

The power switch panels are arranged at one end of the electrical section of the power compartment where they are housed in suitable cupboards.

To match with other coaches to form the complete rake, the roof profile is of the raised type and a height of 13 ft. 0½ in. from the rail level to the top of the roof has been worked to while constructing these coaches.

The arrangements of the baggage compartments are of standard pattern with all steel sliding doors and luggage racks. The carrying capacity of each of these compartments is 2½ tons. For stable running and equal load distribution over the underframes and springs, the compartments have been ballasted with 4 tons of cast iron ballast weights suitably applied.

UNDERFRAMES & BOGIES

The underframes used are of Indian Railways standard mild steel type and the bogies are made up of high tensile steel sections and plates. FAG cylindrical type roller bearing axle boxes are fitted to these bogies.

Close up view of the engine unit.

In view of the higher tare weights of the coaches, the following modifications had to be done to withstand the dynamic loading.

1. Camber of the underframe was increased from 1½" to 2½". Existing truss angles of 3½"×3½"×½" was replaced by 4"×4"×½" size.

2. Bolster arrangements altered by providing six nests of bolster springs comprising two in each per bogie in place of the conventional type of four nests of springs consisting of three springs in each to increase the bolster spring capacity. The other alteration made was to strengthen the bolster spring planks by manufacturing them from 6"×6"×5/8" angles suitably cut for the fitting of the rocker bar seating. This arrangement provided the clear space for the free movement of the anchor pins for Andre shock absorbers fitted on the bolsters.

3. Standard 10 plated springs were replaced by 11 plated bearing springs manufactured from 4"×5/8" spring steel flats. The auxiliary springs were also similarly replaced by helical steel springs in nests of two in each having higher load carrying capacity.

Engine Unit in the Power Car.

4. The fixed type bolster hangers were dispensed with and in their places adjustable type bolster suspension links were fitted. This was done for maintaining the fundamental clearance of $2\frac{1}{2}''$ between the bogie sole plate angle and the underframe transom and for obtaining the required buffer heights. In order to ensure, however, that such clearance and required buffer heights may be obtained without excessive tightening of the adjustable nuts, 1 in. thick timber packings with $\frac{1}{4}$ in. thick mild steel plates on them were introduced below the bolster springs seat plates. It is a well known fact that for good riding of heavy coaches, it is essential that full advantage is taken of the standard effective length of the bolster swing links. Excessive tightening of the nuts shortens this effective length with consequent increase in the periodicity of lateral movements and sets up thereby a high frequency roll. The introduction of these packing had another advantage in that they provided the clearance required between the lateral shock absorber suspension and the bolster spring plank and also ensured centre distances of the vertical type Woodhead Monrœ shock absorbers being kept at 16.5/8 in.

The spring gear on the power cars was designed to obtain a natural frequency from the bogie bolster springs between 110 and 118 cycles per minute and an over-all natural frequency of the entire springing system of about 70 cycles per minute.

Other modifications carried out to the underframes owing to the location of the guard's compartment in the centre and for taking the generator equipments are as follows: (a) hand brake column shifted with necessary alterations to a few hand brake parts, (b) shifting of the train pipe, (c) provision of the trimmer and gusset for the fitting of the bell crank lever, (d) fixing 16 ft. × 9 ft. 3 in. × 5/16 in. mild steel plate on the underframe on the generator end with the removal of the existing top gusset coming on the way, (e) provision of additional angle trimmers for the transformer and radiator mountings, (f) fitting of robust type body brackets of supporting the extension beams for sliding the engine and alternator in and out, etc.

SPECIAL BRAKE RIGGING

These power cars are to run with high speed trains. Bearing in mind that the speed of a train is governed by its ability to stop, it was thought proper to improve the mechanical advantage of the brake rigging so as to raise the brake pressure from a mean value of approximately 36 tons to approximately 45 tons per coach by fitting a revised brake rigging in these cars with an increase in the maximum permissible piston travel to the extent of 6 in., and also by making provision of fitting automatic slack adjusters at a later date on receipt of their supply to give greater reliability and safety.

This entailed modification to the following standard brake parts: brake shaft pull rod arm, brake connecting link short, brake beam and brake vertical lever. The modifications done were in making them stronger to withstand the braking load.

The slack adjusters to be fitted as a trial measure on these power cars are to be of Stopex type, Gresham G. D. type and Westinghouse's Weslak type in three sets of the Power Cars forming three trains.

For efficient braking, Direct Admission Valves have been fitted in these cars. These valves are to ensure

quick admission of air to the brake cylinders, and thus reduce the time lag in the brake application. The principle employed is that air entering the train pipe actuates the D. A. Valves and not the brake cylinder. Air direct from the atmosphere enters the brake cylinder through the direct admission valve, i. e., each brake cylinder has an independent air supply from the atmosphere, as a result of which the operation of the brake gear is speeded up in consequence.

POWER INSTALLATION

The power installation in each power car comprises two generator sets and consists principally of the following equipments—Diesel Engines of the Rolls-Royce type C. 6. SFL Model 131 B series supercharged developing 200 H. P. at 1500 R. P. M., 'Tonum' Alternator-Exciter sets of J. Stone & Co.'s manufacture having a capacity of 165 KVA with starter motor and exciter, Radiator and its fan with motor and A. C. contactors, Starter Battery of the lead acid type with transformer rectifier charger unit with ammeter for 24 nominal volts, Silencer, the exhaust, air filters, differential current transformers and a set of switch gear. The other equipments include tanks for fuel oil, inter-car couplings, Holset couplers between the engine and the alternator, engine control gear and supporting beam, puralators, water trap and stop cock assembly, radiator anti-vibration mountings, etc.

The attendant switch gear includes main and feeder control panels, master feeder line controller, automatic exciter and stabiliser regulator unit, automatic synchronising and load sharing apparatus, engine and alternator instrument panels for both engine and exciter control, and engine protection devices consisting of low oil pressure cut-out and indicator light, low water level cut-out and indicator light, water temperature cut-out and indicator light, pilot lights for 'fuel-on' and 'starting', 'Stop' push button with Mushroom Head and fuel control solenoid.

The engines are connected to the alternators through a "Holset" flexible coupling combined with a Hardy—spicer telescopic propeller shaft for reasons of simplicity with which either the engine or the alternator may be disconnected from each other for periodic servicing and repair without disturbing in any way the electrical installation. This arrangements also ensures the reasonable mal-alignment between the two units can easily be accommodated.

The electrical load of the train is divided between two separate groups of feeders running along each side of the coaches. Under normal full load conditions the two alternators may be run in parallel but with light loads one alternator can be arranged to supply both sets of feeders. When operating in parallel, load sharing can be effected automatically by governor servo motors acting upon the mechanical governors of the diesel engines in response to a 'signal' current received from a differential wattmeter. The same servo motors can be employed for the purpose of frequency control.

Engine starting is accomplished with the help of an axial type starter motor which provides the initial starting torque by engaging itself with the flywheel. A push button control panel installed in the electrical section of the generator compartment of the power car, controls the actual starting and stopping operation.

The starter motor and control circuit derive power from the 24 volt starter battery which remains in a charged condition by the battery charger unit of the transformer—rectifier type connected by means of switches to the main AC bus-bars.

EQUIPMENT MOUNTINGS

The engines are mounted on fabricated frames with suitable anti-vibration mountings arranged between the frames and the engines at each of the corners. The engine frames are in turn supported on two transverse runner members made up of 8″×6″ beams with machined top seating faces. These beams are complete with the brackets incorporating the devices for aligning the engine with the alternator. To these runners extensions can be bolted. These extensions are to extend outside the Car through the side doors and be supported on trestles. This arrangement enables the engine to be slid out sideways into the open where it can be lifted from the runner extensions by means of suitable lifting tackle and obviates the necessity for providing roof traps in the power compartment.

For draining the sumps with the engines in situ, suitable apertures have been provided in the Car floor. These apertures are covered by means of trays which are bolted on to the floor plate and meant for collecting any oil spillage. For manoeuvring the engines into position on the runners, jacking screws are provided to simplify the lining up of the four bolts which secure the engine sub-frame to the runners.

The scheme for mounting the alternators is generally similar to that described earlier for the engines. This also takes the form of two transverse members which in this case are 9″ × 3″ channel sections. They have machined pad surfaces to take on the alternator. Suitable jacking screws with their appropriate supports are incorporated in them for alternator alignment. A collapsible bellow connection between the floor and the alternator discharge outlet has been provided.

Radiators are mounted separately from the engine and have their own electrically driven fans which draw air from the outside of the car through suitable louvres and discharge the same through the roof. As the limitations of the gauge do not permit the inclusion of water proof cowls in the roof of the car, the top of the ducts has been left open and provision has been made at the bottom of the ducts to drain off rain water to the underframe. The radiator arrangement prevent hot air being blown into the power compartment. The radiator rests on rubber pads which sit on a longitudinal angle member forming part of the main supporting framework built up of angle sections.

The motors driving the fans are fully accessible through the louvred openings in the side walls of the Car and have the advantage of the streams of air at outside temperature being drawn through the body side and blown through the radiator coils. The switch gear for the power units have been kept separated as far as possible. In each case the alternator and the feeder control unit is accommodated on a steel framework above the alternator and supported from the underframe. Each steel framework contains three main panels — (a) Alternator inter-locking panel including radiator fan contactor, (b) alternator power panel mounting the main alternator contactor and protective devices and (c) the feeder power panel incorporating feeder contactor and protective devices.

The Isolating Link Box is mounted on a sub-frame between the two main alternator panels. The synchronising and load sharing panel together with differential current transformer is mounted on the electrical side of the partition between the engine compartment and the electrical compartment. The engine instrument panels are mounted on the engine room side of the partition with the projection which accommodates the dials projecting through the partition, so that they are visible from the electrical side. The battery junction box is accommodated under the cat walk between the engines in the engine compartment and is accessible through an enlarged cover plate in the cat-walk which also provides access to the bogie king pin. This junction box is the means of accommodating the main leads from the battery, the two starter isolating switches, from the battery charger and also the various leads which take their feed from the battery.

The warning and Indicator lights panel is accommodated over the door in the end bulk head of the electrical compartment. The battery charger rests on the floor against the end bulk head on the side of one of the power units. Other equipments for the generators like exciter control panel, stabiliser panel, reverse power relay, instrument panel are mounted inside the end bulk head of the electrical compartment.

SILENCER AND EXHAUST ARRANGEMENTS

The silencer and exhaust arrangements have been made in the centre of the roof to take advantage of the narrow extension of the loading gauge. Each silencer is accommodated within a protective cylinder which is open at the bottom and top to provide a free circuit of air for cooling and which automatically aids the ventilation of the engine Compartment.

A hood has been provided above the engine duct surrounding the silencer and cowl above the exhaust fishtail. The exhaust gases from the engine are taken through flexible piping and silencer straight to the roof and provision has been made to ensure against blow back and reverse draught to the engine compartment.

FUELING AND LUBRICATING

The fuel storage capacity provided in each power car is 520 gallons viz: 400 gallons in two main tanks and 120 gallons in two auxiliary tanks. This quantity is considered sufficient for 30 hours run on the basis of the estimated consumption of 8.4 gallons per hour per engine or 16.8 gallons per hour per power car. Facilities have been provided for filling the fuel tanks from either side of the vehicle, an equalising pipe being fitted between them.

Each tank is separately vented with a 3/4″ pipe to roof level. A 3/4″ O. S. dia. 16 Gauge Wall thickness copper pipe connection ensures supply of fuel oil from the main tanks to the auxiliary tanks. Stop cocks are provided to cut off fuel supply in the event of a damaged fuel pipe or other emergency.

The feed to the engine is taken from a 3/4″/3/8″ tee at the lowest level in the main pipe line through the puralator and water trap assembly via a suitable flexible fuel pipe connection to the engine mounting. There is also a fuel spill over return pipe from the engine to the breather pipe of the auxiliary fuel tank.

Each of the main fuel tanks is provided with a mechanically operated fuel gauge and in addition an electrical gauge with remote indicators in the power compartment. The electrical gauge indicates only when the engines are in operation.

Each engine requires 1/2 pint of lubricating oil per hour en-route for topping up.

FIRE EXTINGUISHING

To meet fire accidents, each power car is provided with three different types of fire extinguishers, viz: Soda-acid type, foam type and C. T. C. type, the latter two types being suitable for application against fire from oil & petrol and electric current respectively.

Because of the particular technical characteristics being required and the operating environment being different from other standard coaches, special attention has had to be paid to the constructional features and exterior finish of these power cars.

To improve riding qualities of these Cars, provision has been made for fitting 'Andre' shock absorbers to arrest lateral oscillations and 'Manroe' shock absorbers for controlling the vertical movements.

Aluminium alloy sheets 3/32" thick have been used for exterior panels throughout the coaches while the interior panelling in the guard's staff and engine compartments is of 3/8" plywood construction. To reduce the body weight, timber framings are all in first class Burma teak. Ceiling panels are of 1/8" plywood boards.

Basic colour schemes are white mat finish ceiling and enamel buff interior. The finish of the exterior is carried out in two shades with a green border line running over the windows. The lower panels below the waist rail have been painted in either Gulfred, Brunswick green or Royal blue depending on the regional operation areas to be served by them, while the top panels are painted in pale cream.

Planning and forthright execution of this programme which largely caters to the comfort of the travelling public, only indicates that Indian Railways are moving forward at unprecedented speed, entering new areas of development which were until now considered the preserves of more advanced railways in other countries.

ACKNOWLEDGEMENT

The author is indebted to Mr. D. J. Batliwala, Deputy Chief Mechanical Engineer/Shops, Eastern Railway, Kanchrapara for his kind permission to publish this article and reproduce the photographs showing the different views of the cars built.

INAUGURAL MEETING OF CLASS IV RAILWAY STAFF PROMOTIONS COMMITTEE

The Railway Minister inaugurated the Class IV Railway Staff Promotions Committee whose Chairman is Shri G. D. Tapase. The members include railway and government officials and representatives of railway labour.

Shri Jagjivan Ram in his inaugural address stated that in a large industrial undertaking, the well-being of the worker was a matter of prime concern. Railway gangmen and other categories of unskilled workers, who constituted a large band of loyal workmen had very little chances of advancement. The position may be regarded as somewhat better in the workshops and amongst the artisan category elsewhere on the Railways. Amongst large body of even unskilled railway workers, there should be a good amount of material fit for promotion to the higher categories of railway service.

Continuing his address, the Railway Minister said that he was anxious to do something immediately for this class of railwaymen, which was within his powers, without causing any repercussions on other sectors of employment by such expedients as a wage rise. A mere rise in wages would not give complete satisfaction to the employees. Every person should have the opportunity of advancement provided he was fit for such promotion, he added, and appropriate tests for fitness could be evolved and those who passed such tests should be able to go up even to the very top.

The Committee had also been entrusted with the task of prescribing appropriate tests and drawing up schemes for training courses for the various promotions that they may recommended. In many categories such tests are absolutely necessary in order that the efficiency of the service may be maintained. The tests need not necessarily be theoretical, but should be designed to ascertain whether the employee knew the duties of the job to which he aspired for promotion.

The Minister concluded his address with a request to the Committee to finish their work as quickly as possible so that their recommendations might be studied and implemented before the close of this year.

Manufacture of Telecommunications Equipment in India

By *H. C. Towers*, M. I. E. E., M. I. R. S. E., M. Inst. T.

INDIA has a steady demand for telecommunication equipment. These requirements are increasing with the rapid extension of telecommunication facilities throughout the subcontinent. With the experience of the second world war and the obtaining of independence in August 1947, self-sufficiency in the matter of telecommunication equipment was keenly felt. The largest government user is the Post and Telegraph Department and next are the railways.

The Government of India gave this problem very detailed consideration and finally on 3rd May 1948 an agreement was concluded with the Automatic Telephone and Electric Company of Liverpool and the Government of India. The basis of this agreement was that the A. T. E. Company should provide technical aid and assist India in the manufacture of telephone apparatus according to the schedule of equipment agreed upon. In return the Government of India would purchase telecommunication equipment from the A. T. E. Company through the Indian Telephone Industries, the name given to the new undertaking, until production in India was established. The agreement holds good for fifteen years.

In February 1950 the industry was made into a private joint stock company with three shareholders, the Government of India, the Government of Mysore and the Automatic Telephone and Electric Company. The authorised capital was Rs. 4 crores most of the shares being held by the Central Government. It is anticipated that the increasing activities of the industry will necessitate further increase in the capital.

The Indian Telephone Industries started assembling telephones from parts imported from the Automatic Telephone and Electric Company. This work was commenced in two hangers 175 feet by 75 feet situated on a site not far from Bangalore in South India. These accommodated the tool room, raw material accommodation, machinery awaiting assembly, etc. At the present time these hangers are only used as a store. There are now eight factory units each 220 feet by 120 feet. Two of these have been provided with lean to accommodation 80 feet by 40 feet each. Each unit is self-contained and has four service rooms 55 feet by 20 feet, two at each end. Two are used for washing and toilet and two for stores, switchboards, etc. The natural lighting in the factory is so good that even on dark, cloudy days no general artificial lighting is necessary. Exhaust fans provide adequate ventilation and overcrowding of workers has been avoided.

C. B. Manual Switchboard.

The offices are located in a three storied building in granite with a plinth area of about 13,300 square feet. Accommodation is provided for Administration, Accounts, Engineering, Purchasing and Sales Departments and there is generous room for extensions at both ends of the building. Houses are provided for a total of 1500 families. Amenities include schools, playing grounds, club, hospital, market and cinema. The factory ground covers an area of about 370 acres. Krishnarajapuram Railway Station is at the south east corner of the site and the works has siding facilities.

Relay adjustment.

In the first year of assembling telephones from imported parts, 15,000 telephones were completed. A production programme for manufacture in the initial stages was drawn up and tool making on a small scale was commenced. The staff consisted of 18 officers, 187 workers and 200 others. Five engineers were taken on loan from the Automatic Telephone and Electric Company.

By 1952—53 all the eight factory units had been completed and three canteens. The engineering of the exchanges, hitherto done by the A. T. E. was taken in hand. An order for thirty small channel carrier systems was received from the Post and Telegraph Department. The assembly of telephone exchange equipment was started. Plans were made for the manufacture of dials and condensers and the dial shop was laid out. There was a progressive increase in the sale of manufactured products and distinct from imported products. At the end of the year the staff consisted of 68 officers, 987 workers and 763 others. Psychological tests to ascertain the ability, talent and inclination of workers was further improved and a scheme was introduced for awarding prizes to employees making best suggestions for improvement to the factory and production. During the year 27,209 telephones were made and 8,000 lines of exchange equipment assembled. Recently, dials, uniselectors, uniselector banks and T 2000 selectro banks were new items of production taken up. Development work was carried out on (a) Fire alarm main control unit and sub-stations (b) railway control units (push button type) (c) railway control way station units and (d) magneto telephones. Manufacture of single channel telephone carrier systems was commenced and also a cheap type of 3 channel telephone carrier system was developed.

The factory is being gradually equipped with all classes of machinery. In June 1954 there were 1,050 machines in service. These vary in size from small, cord binding machines received as war reparations and most of these had to be entirely rebuilt. Bakelite moulding presses are installed and the capacity ranges from 27 to 150 tons pressure. All moulded parts for telephones and exchanges are being produced. 61 automatic lathes, capable of turning something like 30 million parts a year, are available. The smaller screws are made in machines capable of producing up to 130 a minute. The tropical climate is very severe on telephone equipment and every component has to be properly treated. The plating shop, which is remarkably free from fumes, provides chromium, cadmium, nickel, zinc and copy coatings. Heavy iron work is spray painted but first thoroughly cleansed from all rust and then bonderised. The rust is removed by spraying the material with steel shots under pressure.

A canteen run by the Employees' co-operative Society, supplies lunches, snacks, coffee and tea at reasonable rates. For those who bring their own food, suitable accommodation is provided for them to eat it in. A free supply of 8 ounces of milk per day is made to workers employed in certain operations such as plating, spray painting, polishing and moulding. A dispensary, with a full time medical officer, is available for first aid and out-patient treatment.

As already stated, the assembly work started early in 1949 and in 1950 the manufacture of parts commenced. The production rate was fixed at 25,000 telephones per annum to be increased as the demand arose. The present demand is somewhere in the region of 50,000 telephones per annum. The telephone consists of

265 items, without the dial, while the dial comprises 122 parts.

Other apparatus being manufactured are Central Battery, Automatic and Magneto exchanges, cable runways, protectors, arrestors and many other items essential for telecommunications. The progress in annual production can be seen from a few details given below :—

	1949–50	1951–52	1952–53
Telephones.	19,216	21,628	27,209
BPO 600 type relays.		11,300	23,277
BPO 2000 type relays.		2,900	46,387

The production programme for the coming years is far more ambitious than this and covers all classes of telecommunication apparatus including all types of railway traffic control equipment. Development is proceeding on transmission equipment. A single channel carrier system has been developed and is under field trial after prolonged laboratory tests. Voice frequency, ringing repeaters and transmission measuring sets are under laboratory tests. The first batch of 'Single channel Carrier Telephone system' has just been completed for supply to the Indian Posts and Telegraph Department. This type of equipment has hitherto been imported and for the first time carrier telephone equipment has been made in India based on the design and development work, carried out by the engineers of the Indian Telephone Industries. The equipment has been designed to utilise indigenous material as far as possible and to have a high degree of reliability under the severe climatic conditions obtaining in India. The first batch of equipment was demonstrated to members of the press and the I. T. I. on 15 May 1953. A device working in conjunction with a loudspeaker demonstrated (i) speech on the voice frequency circuit (ii) speech on the carrier circuit separately and (iii) the effective transmission on the line of the two different talks, one being intelligible and the other not due to carrier technique.

Carrier telephone systems are for use between trunk telephone centres for increasing the number of telephone circuits between them. With a trunk line joining two stations the normal arrangement permits of only one conversation. The 'Single channel carrier telephone system', which comprises two terminal equipment, one of which is fitted at each end of the trunk line, increases the number of circuits from one to two thus making it possible to put through two calls at the same time. The maximum range of the system is 250 miles but by employing repeaters this range can be considerably increased. The additional speech circuit can only otherwise be obtained by the installation of a second trunk line. The cost of erecting a pole line of 100 miles with two copper wires would be over one lakh while the cost of 'Single Channel Carrier Equipment' giving the same facility would be about one sixth of this. The circuit provided by the carrier system is of better quality, less susceptible to weather disturbances and more flexible for operating requirements.

Carrier technique enables the simultaneous transmission of the message originated by two or more subscribers independently of each other at the same time. Taking the case of the 'Single Channel Carrier Telephone System', which permits two conversations at the same time, one of the conversations passes over the line in the usual manner while the signals corresponding to the second conversation passes through the carrier equipment to be modulated with a high frequency called 'carrier'. This modulated signal corresponds to the original signal with the only differences that the frequency is shifted into a higher range and passes over the line without interfering with the original conversation. The terminal arrangements at the other end is a selective circuit called a 'Filter' and restores the conversation to the original form by demodulation.

The I. T. I. have been keenly alive to the importance of Research and Development in long distance line communication equipment. By June 1950 a development section for line transmission equipment was established. The 'Single Channel Carrier' was taken

Assembling telephones.

up for development and quick progress was made. By January 1951 a working model was ready and this was exhibited in the Communication Engineering Laboratory of the Indian Institute of Science when opened by the Prime Minister of India. A complete system was ready by March 1952 and placed on field trial between Guntakal and Secunderabad. This system is still in service and working well. The Indian Posts and Telegraphs placed an order for 30 systems of this type. Other development work includes Voice frequency repeater, Secrephone and Transmission measuring set and prototypes are ready for field trial. Development of a three channel Carrier Telephone system is in an advanced stage.

To meet future demands for carrier and allied equipment in India, plans have been finalised for the early manufacture of such equipment on a large scale. Necessary buildings, machinery etc. have been arranged so that the bulk requirement of such equipment will be manufactured by I. T. I. The demand for new telephones is generally insatiable and it is recognised that in spite of the enormous expansion of the Indian Telephone Industries since its inception, the workshops will still have to undergo considerable development to meet the demands of the coming years. The objective is to make the country self-sufficient in telephones and long distance equipment in the shortest possible time.

INDO-SWEDISH TRADE AGREEMENT

According to an official announcement, the schedules attached to the Indo-Swedish trade agreement have been slightly modified for the current year. It may be mentioned that the agreement provides for revision of schedules every year. Important items included in the list, amongst others, for exports from India are : Manganese ore, magnesite, kyanite, chrome and iron ores, and for imports into India are : iron and steel including ferro alloys and stainless steel, metal manufactures and semi-manufactures, various machinery and industrial equipment e.g., diesel engines, metal and woodworking machinery, ball and roller bearings, electrical equipment e.g. generators, transformers, railway rolling stock and locomotives etc.

TRAVEL CONCESSION FOR BLIND AND T. B. PATIENTS

Travel Concessions in I, II and IIIrd classes for blind persons and tuberculosis patients announced by the Railway Minister in Parliament in June, came into force with effect from July 1, 1957.

Under these concessions, a blind person accompanied by one attendant can travel on payment of one single journey fare. A blind person travelling alone will be permitted to travel on payment of one-fourth of the normal fare. In either case the blind person will be required to produce a certificate from a registered medical practitioner.

Similarly, a T.B. patient accompanied by one attendant will be charged only one single fare, provided he is travelling for admission to or on discharge from a recognised T. B. hospital or sanatorium. When travelling alone for admission or on discharge a T. B. patient will be charged only one-fourth of the normal fare. A certificate from the officer in charge of the hospital or sanatorium concerned would have to be produced in either case.

* * *

USERS CONSULTATIVE COMMITTEE MEETS

The Bombay Divisional Railway Users' Consultative Committee held its Meeting at Pandharpur on 16th June, 1957.

A proposal to make announcements on Loudspeakers at Dadar and Kalyan for the information of passengers giving the position of compartments for Dadar and Kalyan Passengers in the Down Mail and Express trains before the arrival of these trains at these stations was accepted. A suggestion to replace the present 'Blank Card' tickets with Blank paper tickets with three counterfoils, for audit, record and passenger to avoid any fraud being committed was also agreed to.

It was pointed out that it is only under extreme and unavoidable circumstances and sudden developments that the decision to cancel trains has to be taken quickly and thus there was absolutely no time to publicize such decisions. In all cases where cancellation of a train is decided upon much in advance, publicity in newspapers is invariably given.

Among other subjects discussed were, the placing of wagons at Mill Sidings, unloading of wagons by the Railway within the free time allowed, use of damaged wagons for loading grains and action taken against unauthorised passengers occupying reserved compartments.

KHANDWA-TAKAL LINE OPENS

JUNE 18, 1957 was the auspicious day on which the first 18½ mile line from Khandwa to Takal of the Khandwa-Hingoli Metre Gauge Rail Link was formally opened for goods and passenger traffic. Dr. Kailas Nath Katju, Chief Minister of Madhya Pradesh, performed the inaugural ceremony at Khandwa in the presence of a large and distinguished gathering.

The inspection of the guard of honour by the Chief Minister and presentation of officers to the Chief Minister was followed by the welcome address by Shri M. N. Chakravarti, General Manager of the Central Railway. The work of construction of this vital rail link began a bit over 3 years ago, Shri Chakravarti stated, the starting point having been Khandwa itself. The Central Railway served a number of States and out of its route mileage of 5,300 nearly 1,400 miles were in the State of Madhya Pradesh. Much of the coal, lime, lime-stone and cement and the abundant agricultural and forest produce of Madhya Pradesh was transported by the Central Railway to consuming centres all over the land, he added.

This Railway thus served very substantially the State of Madhya Pradesh through which it extended in the form of a closely integrated network and to all railwaymen working in this great State, it was a proud privilege to serve. Referring to the opening of the first section of the Khandwa-Hingoli railway line, Shri Chakravarti stated that the new link from Khandwa to Hingoli would be 187 miles long and about one fourth of this would lie in Madhya Pradesh, the remaining portion in the Bombay State. When this link was finally forged, the gap which at present existed between the Northern and the Southern metre gauge systems would be closed. The serious operational problems presented by the separated systems would end. The maintenance of two separate wagons and engine pools for the Northern and Southern metre gauge systems lacked flexibility in operation and handicapped the administration in the free movement of traffic. On completion of the link, this would be overcome and a metre gauge wagon would be able to travel right through from far off Tinsukia in the Northest corner of India down to Trivandrum or Tuticorin in the South.

The second section to be opened in the course of the next few weeks would be an 18-mile from the Hingoli end upto a station called Kanhergaon, he added. The lines would thus be progressed and before the end of 1959, subject to timely availability of the vital building materials, the entire line would have been completed.

The General Manager expressed special thanks to the Hon'ble Chief Minister and to his Government and its officers for the ready help afforded to the Railway in settling numerous problems both big and small. He thanked Pandit Babulal Tiwari and Sri Raichanda Nagda for all their co-operation and assistance. To the Western Railways, his thanks were due, he said, as they had arranged to run the metre gauge trains on this section. He also thanked his officers and staff who had worked hard to build the new line.

Sri Thadani, Engineer-in-Chief then gave the salient features of the new line. Its history dated back to 1882 when a proposal was mooted for constructing a railway line between Akola and Hingoli. As far back as 1903, the need for this link from the strategic point of view was stressed. In 1911 the final location survey of the route was made, the alignment selected being Via Akot, Akola and Basim which conforms broadly to the alignment now adopted.

The new line after leaving Khandwa passes through a fertile tract for the first 21 miles and then ascends the Satpura ranges making its way through deep cuttings over high embankments and by bridges across rivers. After passing Tukaithar station, almost 40 miles from Khandwa, the line enters Bombay State in a wild and mountainous region known as the Melghat. It is between this point and Akola that the only two tunnels with a combined length of half a mile and the longest bridge with 8 spans extending some 1050 feet across are located. There will be 26 new stations over the whole line.

Shri Mandloi, Revenue Minister of Madhya Pradesh then addressed the gathering. Our country had the highest railway mileage in Asia and we compared favourably with the rest of the world, he said. We would have to pay more and more attention to the railways and railwaymen in the country. In the last war, railway staff had played their part nobly and well. Much of the success of our First Plan was due to the Railways which had moved all the food needed and all the products of agriculture and industry to all parts of the country

(Continued on page 19)

A New Range of Mechanical Lubricators

A new range of mechanical lubricating equipment is now being manufactured in Great Britain. This is the result of an agreement between Davies & Metcalfe Ltd., Romiley, Stockport, and Alex. Friedmann, Vienna. The latter company have manufactured high class mechanical lubricators and accessories for very many years and are well known in most parts of the world.

The firm of Davies & Metcalfe Ltd., are very old established Locomotive Engineers who have manufactured Exhaust Steam Injectors, Vacuum Brake Ejectors, and Live Steam Injectors, etc. for almost every railway company in the world. They therefore have all the engineering knowledge, both practical and theoretical, and all the design experience, to ensure that they can manufacture precision mechanical lubricators with that high degree of accuracy and finish that is so necessary.

A feature of this equipment is the very excellent design and general high class of workmanship throughout, and it will be noted that the pump units operate on a system which obviates the use of ball valves for the inlet and outlet ports, a point of utmost importance for reliable lubrication.

At present, this Company is concentrating on lubricating equipment for steam, diesel and electric locomotives, but it is their intention to widen their field almost immediately to include industrial and marine lubricating requirements generally.

In connection with locomotive lubrication, they manufacture the Metcalfe Automatic Steam Brake Cylinder Lubricator, the Friedmann type F. S. A. Valveless Mechanical Lubricator and D. V. Pattern Lubricator, which is a standard lubricator for many of the world's largest railways, also Wheel Flange Lubricators, in addition to a wide range of fittings and appliances for use in conjunction with mechanical lubricators such as low and high pressure terminal check valves, oil dividers, atomisers, unions, etc.

An entirely separate lubricator department has been constructed at the Romiley works and this will ensure that all lubricating equipment is assembled and tested under ideal conditions. When we recently visited these works, we were pleased to note that special steps had been taken to ensure perfect cleanliness throughout this new department.

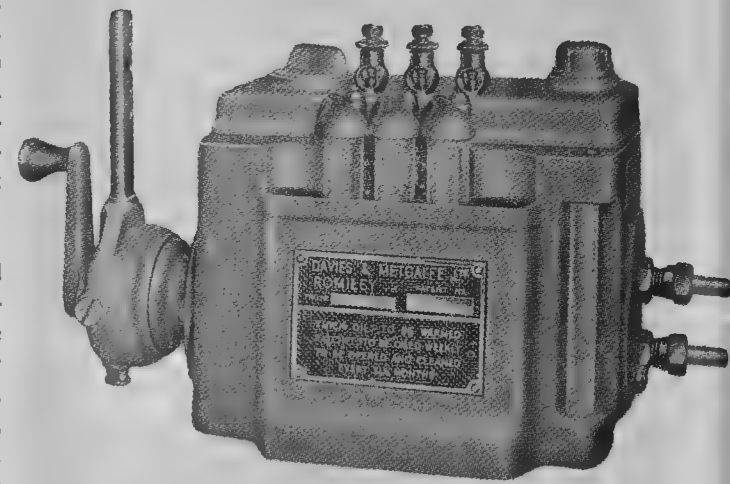


Fig. 1

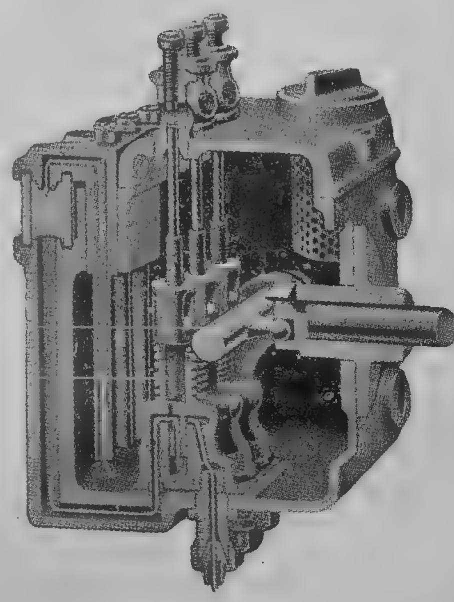


Fig. 2

Figs. 1 and 2. The Type D.S.I. Lubricator is very soundly designed and constructed and may be used for most industrial purposes.

THE TYPE D. S. I. MECHANICAL LUBRICATOR

This style of lubricator is suitable for general industrial and marine applications, and it is capable of using all normal grades of lubricating oil. Figure 1 shows the lubricator which, it will be noted, is equipped with sight glasses to each feed.

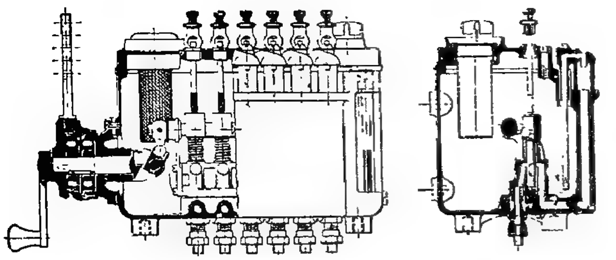


Fig. 3. Sectional drawing of the D.S.I. Lubricator.

The working of the lubricator may be seen from Figures 2 and 3, and the method of pump operation is by a shaft common to all pumps which lifts and simultaneously turns the plungers. This movement automatically opens and closes the suction and delivery ports of the pump units so that no ball valves are required in the operation of the lubricator which is thus free from the failures and troubles associated with lubricators employing ball valves. An additional advantage of this system is that it is safe to arrange the sight feed to be on the suction side of the pump without fear of the oil thus sighted not reaching the lubricating point.

The advantage of sight feeds of this type is that there is no need to pass the oil through water or glycerine, and thus the likelihood of broken sight glasses, freezing of water, displacement of water by oil, etc., are all eliminated. The makers claim that since there are no valves to interfere with the flow, all oil reaching the delivery side of the pump, must pass to the outlet side.

Rate of delivery for each plunger can be regulated by adjusting its stroke. Regulating screws are fitted to the top of the oil container and range of delivery is from 0 to 0.33 c. c. per stroke. As the tail end of each plunger rises, it passes through the top of the container to meet the regulator screw, thus visible observance of its motion is possible.

Should any oil accumulate in a sight feed glass, it is only necessary to loosen the top screw just above it, when surplus oil will at once disappear. A gauze filter is fitted under the filler cap, and a steam heating pipe, for use with very thick oils, or the ensure constant temperature of the oil at all times, can be fitted if required. Steam pipe connections can be seen in the unit illustrated. Fixing lugs or studs can be incorporated to suit the customer's requirements.

THE RATCHET DRIVE

The method of driving the lubricator may be by ratchet from reciprocating motion, or by chain or reduction worm gearing (standard ratio 38.1) from rotary motion and the drive may be arranged on the right or left underside of the body in addition to the front position which is shown in Figure 2. The type of ratchet drive employed attracted our attention, particularly when we were viewing the arrangements being made to produce these lubricators. One of the most frequent sources of trouble on ratchet driven lubricators is the ratchet itself, and is usually due to a faulty pawl, or to wearing of the ratchet wheel teeth. The fitting of a trouble-free ratchet is a valuable asset to any mechanical lubricator.

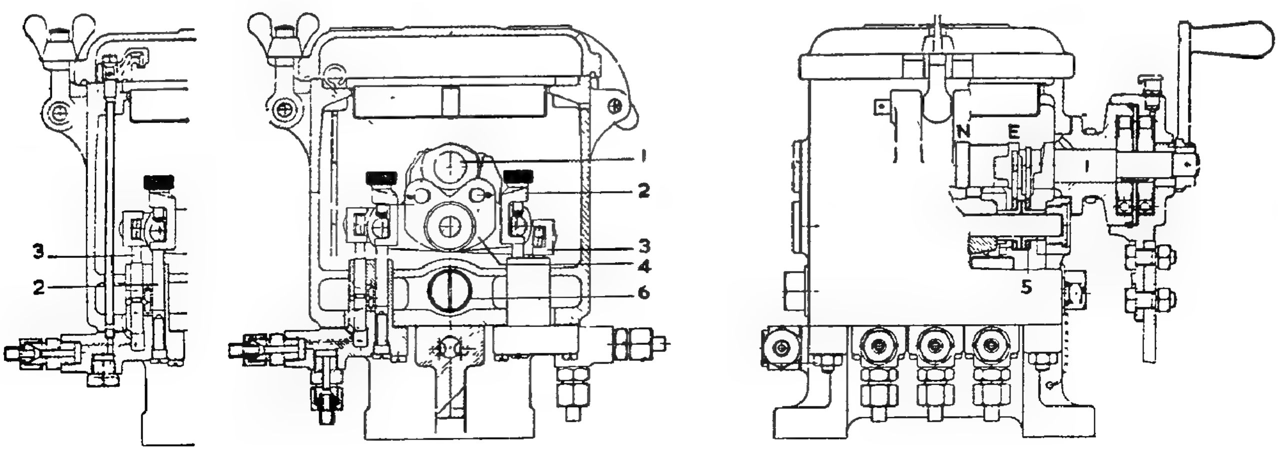


Fig. 4. Sectional drawing of the Type F.S.A. Lubricator. LH drawing shows method of converting pumping units to single feeds instead of double ones.

The arrangement of this ratchet assembly can eb followed from the sectional drawing of one included in Fig. 4. The drive consists of two discs each having five rollers which are spring loaded. One set of rollers and disc is for driving and the other set is to prevent backlash. The advantage of this system is that complete absence of backlash is maintained over prolonged service, a positive drive is ensured under all conditions no matter how short the stroke of the operating lever, there is freedom from wear, and operation is silent.

RANGE AVAILABLE

A full range of these lubricators to meet most industrial purposes is, or very shortly will be, available. There are to be seven sizes of container to hold from one to twenty-one pints of oil, and they may be divided into two or more compartments, if required, to separate differing grades of lubricant, e. g., cylinder and bearing oils. Any number of feeds from one to nineteen may be incorporated. Non-return valves, for fitting near to the points of lubrication, are provided when these lubricators have to feed against steam or air pressures.

THE TYPE ' D ' MECHANICAL LUBRICATOR

This lubricator is identical in construction and operation with the type D. S. I. with the exception that it is not fitted with sight feed glasses, and is consequently somewhat simpler and cheaper.

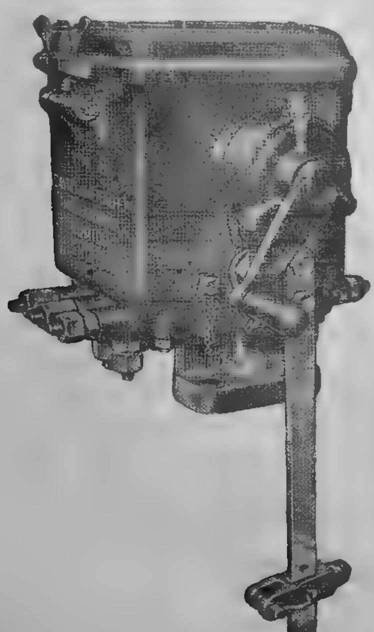


Fig. 5. The type F. S. A. Lubricator, designed primarily for locomotive work.

THE TYPE F. S. A. LUBRICATOR

This lubricator is designed for heavier duty, primarily for use with steam locomotives, and is illustrated in Figs. 4 and 5. This again, is a valveless lubricator and each pumping unit has a delivery and distributing piston. The pumping units are an exceptionally high class precision made job, the pistons being perfectly oil-tight up to a pressure of 3,000 lb./sq. in. and the delivery to oil is most accurate and reliable under any conditions of working. They are valuable lubricators for use on all types of steam engines.

Referring to Fig. 4. the driving shaft, 1, is supported in the body of the lubricator and has five cams formed on it, as illustrated. The cam marked "N" is a double one and operates the delivery pistons, 2, whilst the two sets of eccentric cams, item E, operate the distributing pistons, 3. The delivery pistons are operated through the delivery piston rocker, 4, and the distributing pistons by means of the distributing piston rockers, 5.

The arrangement of double and eccentric cams for delivery and distributing pistons is a feature of the design of this lubricator and enables each delivery piston to make two strokes per revolution of the driving shaft whilst at the same time, the distributing piston makes one single stroke. Thus, each pumping unit may be termed double acting and for a revolution of the driving shaft, oil may be delivered separately and independently from the two outlets provided on each pumping unit. There may, incidentally, be one or two outlets as required.

Regulation of total delivery is made by altering the travel of the operating lever, and also by varying the outlet of individual pumps by adjustment of the piston stroke. Since one regulating screw alters the output of two outlets, two similar points, e. g., pistons, valve guides, axle boxes, etc., may advantageously be connected to the two outlets of one pumping unit, thus ensuring identical quantities of oil being delivered to two similar points.

A filling strainer is provided but a further strainer, 6, ensures that only clean oil can reach the pumping units. This is an additional safeguard against some uninitiated person filling up the lubricator with the filler-strainer removed.

The F.S.A. lubricator is made in two sizes. The small one has up to twelve outlets and the larger one up to 24. The number of outlets in each case may be

varied by converting the pumping units to single feeds and substituting the internal drip pipe, as shown in Fig. 4.

A full range of accessories are available, as with all Davies & Metcalfe lubricators, including check valves, atomizers, unions, etc. Sight feed indicators for fitting in the delivery lines are also available. When the lubricator is employed for steam locomotive work, terminal check valves may be employed for feeding against steam pressure and as these incorporate feed test cocks, sight feed indicators may not be needed.

THE METCALFE OIL DIVIDER

Where it is desired to increase the number of points fed from a lubricator and where additional feeds are not available on the lubricator itself, the Metcalfe Oil Divider provides a solution. This is made with two or four outlets and the value of this piece of equipment is not so widely known as it should be, since its uses are very numerous throughout lubrication systems.

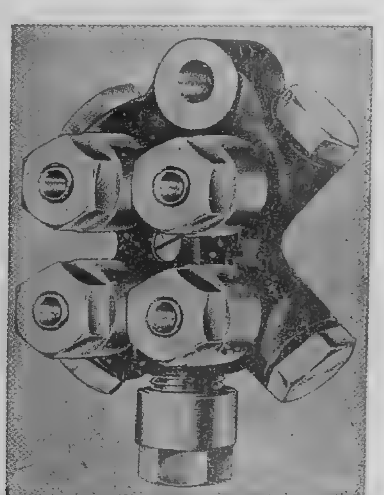


Fig. 6. The Oil Divider allows a lubricator pump to feed several points without the disadvantages of "split" feeds.

It is well known to Lubrication Engineers, that it is dangerous to employ split feeds for lubrication of important points because the oil always takes the line of least resistance and whenever one line gets partially choked, all the lubricant goes the one way. The Oil Divider allows a small sized lubricator to feed to a greater number of points than there are pumping units, without fear of starvation of any point. When connected in tandem, the Oil Dividers will still further increase the number of points that can be fed, providing it is borne in mind that the last points in such a circuit will only receive their "divided" supply. The Oil Divider is illustrated in Fig. 6, and Fig. 8 shows how it may be connected into a lubrication system. Fig. 7 is a sectional illustration.

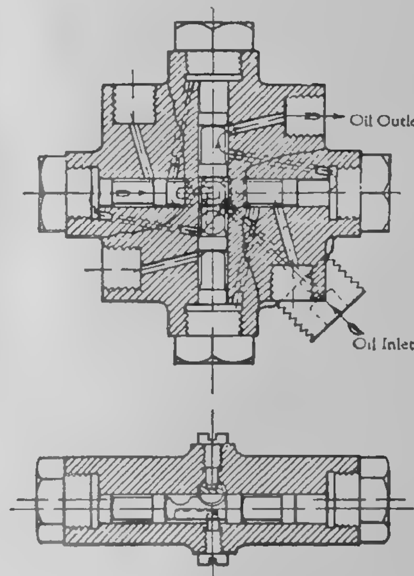


Fig. 7. Sectional drawings of the Metcalfe Oil Divider.

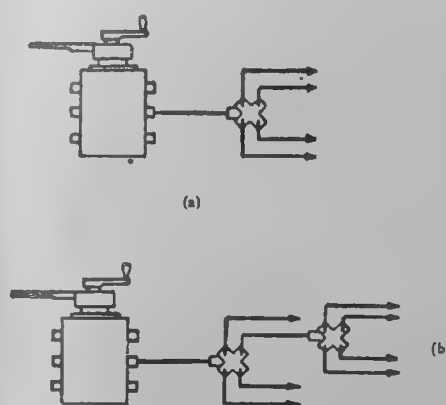


Fig. 8. Illustrating methods of connecting (a) one Oil Divider to feed to four points, (b) two or more Dividers to feed to seven or more points.

Oil is supplied to the Divider from a feed of the mechanical lubricator. The Divider has two pairs of oil-tight pistons which slide in cylinders formed in the body of the Divider. Each piston and cylinder has inlet and outlet ports, and the construction is such that the inlet port of only one piston is open at a time. In

operation, the pistons move in a cycle and oil is delivered from each outlet union in turn, under the same pressure as the delivery from the lubricator.

The advantages of the Divider may be summarized as follows :—

(1) A great number of points may be lubricated from comparatively few pumping units.

(2) Each point is fed with a positive supply of oil as soon as the lubricator commences to work, and supply is proportional to the speed of driving the lubricator.

(3) Regulation to a fine setting at the lubricator pump, ensures economical lubrication.

(4) Positive supply of oil to each point is irrespective of the difference in resistance to flow of each of these points.

(5) The use of Oil Dividers may save the cost of an expensive lubricator employing additional individual pumping units. In addition, a considerable saving in space and cost is effected since multi-feed lubricators can be large, unwieldy and costly.

CAN BE USED WITH SOFT GREASE

The Oil Divider is generally used in conjunction with a mechanical lubricator and requires a minimum of 75 lb./sq. in. pressure to operate it. It will work with all grades of oil and also with soft greases. Whilst primarily intended for use on low pressure lubricating points, using the Metcalfe standard low pressure terminal check valve, it is quite suitable for normal lubrication.

Adjustment of the delivery capacity of the pump feeding the Divider automatically increases or reduces the number of operating cycles of the pistons inside. Thus, whilst the amount of lubricant discharged per cycle is constant, the frequency of discharge is adjustable. The standard Divider discharges 0.028 cu. in. of lubricant from each piston per cycle. All Dividers are tested before delivery against a pressure of 500 lb./sq. in.

The Divider requires no maintenance beyond occasional dismantling and washing out with paraffin. Service life is claimed to be exceptionally long in view of the high grade materials employed and which always run in oil. Replacement pistons are not therefore supplied, and when wear does eventually take place, a new unit should be installed.

STEEL IN INDIA

Though India is second only to Brazil in the possession of the world's largest reserves of high-grade iron ore, her output constitutes only 2 per cent of the total world production—compared to U. S. A.'s 43 per cent and U. S. S. R.'s 18 per cent. India's annual output of steel is a little less than 1.5 million tons compared to 17 million tons in the U. K. and over 100 million tons in the United States. India consumes only 11 lbs. of steel ingots per head in comparison with U. S. A.'s 1,237 lbs., U. K.'s 628 lbs., Australia's 540 lbs. and Italy's 137 lbs.

The First Five-Year Plan accorded high priority to the expansion of the steel industry and laid down a target capacity of 1.65 million tons of steel (as against 1.01 million tons in 1950-51) to be attained by 1957-58. By the end of the First Plan, the Government of India decided to set up three steel plants of 1.0 million ton ingot capacity each in the public sector, located at Rourkela (Orissa), Bhilai (Madhya Pradesh) and Durgapur (West Bengal).

*** *** ***

COAL

According to a report, preliminary data collected by the Geological Survey of India and of the Indian Bureau of Mines coal resources in India are much in excess of what has been estimated so far. With 60 drilling machines secured by the Union Government from abroad—40 from Russia—extensive drilling operations have started recently in all prospective coalfields. Parties are working in West Bengal, Karnapura and East Bokharo in Bihar and in Rewa in Madhya Pradesh. Much of the new find is believed to be of selected grade. Drilling in the West Bengal coalfields near Ondal has shown that below a depth of 2,200 feet, there are big seams of coal. Boring in East Bokharo and Karnapura coalfields has proved conclusively that there are thick seams of number one and selected grade coal at shallow depths. Similarly, deposits of coal have been found in the Rewa coalfields. Drilling operations will soon begin in the Singaruli coalfield near Mirzapur in Uttar Pradesh, preliminary investigation into which indicates the existence of large seams of coal.

It is reported that output of coal in India during May last was higher at 3,794,092 tons compared with 3,726,290 tons in the previous month of April. It is learnt that the Union Government intend to introduce in Parliament some time in October a Bill seeking amalgamation of small colliery units on the lines suggested in the report of the Collieries Amalgamation Committee set up earlier under the chairmanship of Mr. Balwantrai Mehta. The basis of amalgamation recommended by the committee was that the output of any colliery should not be less than 10,000 tons p.m. for a period of 50 years.

(Continued from page 13)

"I am happy to note that to-day, the Khandwa-Hingoli rail link surveyed over 75 years ago, is becoming a reality, in the first lap of our Second Five-Year Plan", Shri Mandloi said. Khandwa could be justly proud of this achievement—the linking of the North and the South. This link would now solve several complicated problems. He urged that all attention be paid to develop the regions of Madhya Pradesh. Shri Mandloi concluded with his heartiest thanks on behalf of the people of Khandwa to all railwaymen.

Shri Babulal Tiwari, M. P. then addressed the distinguished gathering. Recalling the turning of the first sod at Khandwa when the project was launched by Shri Lal Bahadur Shastri in 1954 he said, it was indeed gratifying to note that the completion of this link was no longer a dream but was a reality. This railway line passed through areas populated by the poorer and backward classes of Madhya Pradesh, and the provision of this rail link would ease their hardships. When this rail link was completed and opened to traffic it would increase the prosperity of the State of Madhya Pradesh.

Winding up the speeches before the inaugural address of the Chief Minister was Shri Siddiqui, Food Minister, Madhya Pradesh. The gap between the Northern and the Southern Metre Gauge systems was being linked up by the present construction he said. This line would serve the economic needs of the poor and illiterate masses in the area. It was said that the bowels of the earth stored great wealth and he expressed the hope that the linking up would enable the people to reap rich harvests.

The Chief Minister of Madhya Pradesh, Dr. Kailas Nath Katju then delivered his inaugural address. He was happy he said, to be in the midst of this distinguished gathering. Khandwa station was not new in him. As the General Manager had earlier pointed out, Dr. Katju said if one had to proceed to Kanyakumari, or to Kerala, it was the Metre Gauge system that took one there.

This rail link of 187 miles now being constructed way in the nation's interest. The brochure which had been circulated made interesting reading, the Chief Minister said. This linking up of the north with the south had engaged attention for well over 75 years but for one reason or the other it was shelved. In the wake of the freedom of our country this question again came to the fore and had now finally been taken in hand. He was very happy, he said, that the first section of 18 miles from Khandwa to Takal had been completed and was now ready for traffic.

Another section of equal length from the Hingoli end was being completed and would become ready for traffic in a couple of months. It was his earnest hope that within a couple of years the entire rail link between the north and the south would be completed. One could then make his home in a metre gauge compartment travelling from Gauhati to Kanyakumari without the bother of transhipment at any point. "I still remember the Grand Trunk Express train of old which ran from Peshawar to Mangalore and other train from far off Pathankot to Madras", Dr. Katju stated. "How shall I describe this Link? It has linked up the entire country", the Chief Minister said. Khandwa should be justly proud of this achievement and has the unique distinction of being the starting point of this unique vital link. He congratulated the General Manager, the Engineers and labourers for this achievement. Concluding his address he expressed the hope that more and more tracts of Madhya Pradesh would be linked up to improve the prosperity of this State.

Shri D. P. Mathur, Senior Deputy General Manager proposed the vote of thanks. He expressed the Administration's grateful thanks to the Hon'ble Chief Minister for having come all the way to Khandwa to perform the opening ceremony and to the Hon'ble Revenue and Food Ministers and to Shri Tiwari for having addressed the gathering. He thanked the distinguished guests for their presence and all those who had assisted with the arrangements from the Khandwa and Bhusawal Divisions.

It was a couple of minutes before the scheduled departure of the inaugural train. The General Manager then requested the Chief Minister to perform the inaugural ceremony by pulling the miniature lever on the table. And as Dr. Katju did so, to the lowering of the signal in the pandal and the starter signal for the train, the Protection Force band beat a trumpet call whilst the engine of the train let out a sharp, shrill blast. All heads were turned towards the inaugural train headed by a gaily decorated engine, which amidst clouds of steam and smoke, started out on the inaugural run bound for Takal.

The function concluded with the presentation to the Chief Minister by the General Manager of the lever used to perform the inaugural ceremony and the playing of the National Anthem.

Belmos "G" Range Control Gear

A NEW Range of medium voltage a. c. Motor Control Gear Switchboards, designated the "G" Range, is now in full production by The Belmos Company Ltd. of Bellshill, Lanarkshire. This compact and attractive design in four and five tiers covers the many applications now arising in industry where a number of standard direct-on-line starters for three phase motors are best grouped together as a switchboard, with either local or remote control.

A typical "against-the-wall" Switch Board with Incoming trunking at left

The space saved is 20 to 30% compared with a two and three tier construction, such as the well established BELMOS "D" Range which the new design supplements. Further space can be saved by using a version of the design which permits the switchboards to be mounted directly against a wall.

Individual isolation and back-up h.r.c. fuse protection are provided as standard, and other features which can be added include ammeter, indicating lamps, 110 volt control circuit, and sequence interlock between starters. Already several installations, each involving over two hundred and fifty starters, have been supplied for new continuous process plants; these have demonstrated the soundness and flexibility of the basic design which enables the gear to meet the differing requirements of a variety of users in the most modern applications. Simplification and standardisation enable the range to be offered on short delivery.

The flush-fronted switchboards exhibit the well known BELMOS attention to appearance, robustness and accessibility. A choice of five attractive stove-enamelled colours is offered as the standard finish. The five tier cubicles accommodate direct-switching starters up to 12½ h.p. at 440 volts, and the four tier up to 40 h.p. (and occasionally up to 70 h.p.). When larger horsepowers or multistep starters are also involved, housings of one or two tiers can be supplied to match. A new leaflet, reference K 450, describes and illustrates this new development from Scotland in some detail.

HINDUSTHAN MACHINE TOOLS

As a result of the reorganisation of production schedule, the Company was able to achieve an output of 135 machines in 1956–57, as against the original target of 57 machines. Production during 1957–58 is expected to exceed 400 machines, as against the original target of 131 machines. The revised target for 1960–61 is double the original target of 400 machines, to be achieved by working multiple shifts and increased efficiency. A technical collaboration agreement with the West German firm of Fritz Werner was signed in January last for the manufacture of horizontal, universal and vertical milling machines. Negotiations for technical collaboration, it is stated, are in an advanced stage for the manufacture of radial drills and heavier lathes. In addition, the Government has approved in principle the establishment of a foundry estimated to cost Rs. 60 lakhs; the initial planning and layout of the foundry has been completed and tenders invited on a global basis.

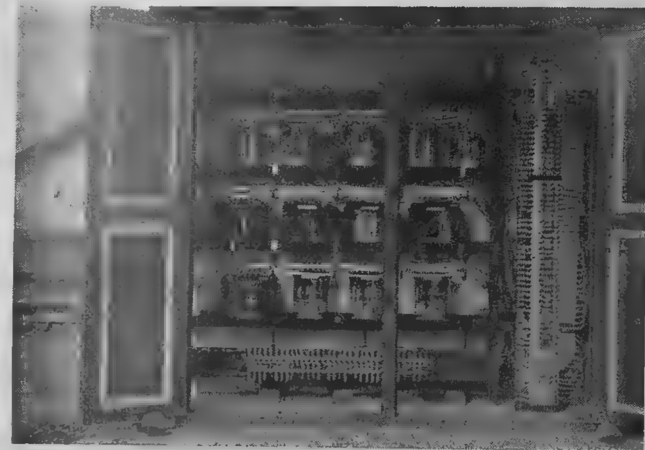
Cables and Connections for Railway Signalling and Interlocking Circuits

By H. C. Towers, M.I.E.E., M.I.R.S.E., M.Inst.T.

FOREWORD

IN the early days of railways the only electrical appliance concerned with train operation was the telegraph the use of which was initiated by the Great Western Railway in 1837 following successful experiments by the inventors, Cooke and Wheatstone. Later, electrical indicators of various types were introduced for performing a number of functions to assist train working. These appliances did not require many wires and an earth return was used as part of the circuit. No particular form of wiring was necessary and the quantity involved was small. The commencement of the present century saw the inauguration of power signalling in this country. Rapid progress was made with this form of signalling with the construction of the Piccadilly, Bakerloo and Kampstead lines of the then London Electric Railway and the electrification of the District line. The new signalling required a large number of wires for connecting the apparatus as compared with earlier telegraph circuits. During fifty years of development the quantity of electrical equipment and the number of wires has increased enormously. The present day demands are for quickly detachable, plug in apparatus and pre-wired relay racks and similar facilities.

The first power signalling installations constructed in the United Kingdom favoured the placing of relays and fuses in polished wooden cases. Those containing relays sometimes had glass doors of the lift out type. Except for very large installations, the fuses were generally mounted at the bottom of the relay cabinet this portion of the door having wooden panels. The incoming cables were brought into the basement of the signal box, where the electrical apparatus was usually housed, in wooden troughing or trunking. The cores were stripped of the outer insulation and protective sheath at the point where the relay cabinet was entered, taped, and run in smaller trunking, or treed, to the fuses. The wires were attached to the fuse bases by O or 1BA termina and fed through a hole in the mounting board into the main run. In nearly all these early installations it was the practice to hide the wiring out of sight but it may be assumed that the policy then was to secure its protection rather than to conceal it from view.



Relay and terminal cubicle constructed in brick and asbestos as used on Western Railway, Bombay section, India.

The cables were mostly run underground or through ducts the method depending on the locality and the nature of the ground to be negotiated. Some railways used wooden trunking of substantial section, mounted on short posts. Single wires were run inside the trunking. Other railways ran cored cable direct from the fuse case in the signal box to the function out on the track. For example, a power operated signal might require five wires for the operation and indication circuits. These would be run in a five core cable from the fuses direct to the signal post. If it was necessary to loop the cable through a point detection box it would be taken down to the permanent way and back again. Intermediate disconnection boxes were not considered then and often connections were made outside the signal box by means of plumbed joints. Cable faults were frequent particularly in damp places.

The year 1923 marked the commencement of the various extensions and modernisation of the London Transport Railways and this period initiated a new era in power signalling and the introduction of more modern methods in cabling and wiring. In early power installations, where a signal read over a pair of facing points, it had to detect that those points were correctly set and locked before it could show "Proceed". This was accomplished by taking the signal control circuit through a contact box fixed to the point sleepers which

opened and closed contacts according to the position of the points. The practice of breaking the signal control cable for this purpose was not a good one and it introduced the possibility of failures and cable faults. The point detector was therefore made to operate a point detector relay in the signal cabin, the relay working on a polarised circuit being energised one way when the points were normal and the other when the points were reverse. The detection of the points by the signals was then carried out inside the signal cabin, with internal wiring, the signal control cable running direct to the signal. This principle of repeating functions out on the track by relays in the signal box and running cables direct to the apparatus they operate was introduced as general practice.

MULTI CORE CABLES

Although some railways prefer to use a separate cable for each point or signal, the general practice today is for all circuits to enter and leave the signal box in main cables which are looped into location cases at convenient situations along the cable route. The number of cores in a cable are usually kept to a standard number in order to avoid having a large number of cables of different sizes. For example, the smallest cable may be a 5 core and the largest 61 cores with intermediate sizes of 12 core, 10 core, 27 core, 37 core and 48 cores. The gauge of wire used is 0.064 or 0.044. Larger diameters are used in special cases while the size of the signal main supply cable varies proportionately with the load. The insulation and armouring of multi core cables is usually to the British Standards Specification or to the railways specification where some overseas installations are concerned.

Track and signal relay location using cast iron boxes. Western Railway, India.

Part of relay rack in basement of signal box at Bandra, Western Railway, India. A steel platform between the two racks gives access to the interior of the power frame.

These cables are manufactured for burying direct in the ground and this is what most railways require. This leaves the earthwork immediately adjacent to the permanent way free of obstruction and the cables are not liable to damage in case of derailment. Some railways prefer to have their cables above ground running them in cable brackets fixed to short posts, spaced four to six feet apart. Another method is to use railposts fifteen to twenty feet high and twenty feet or more apart. The cables are slung from a steel messenger wire stretched tautly between the posts and regulated at intervals by adjusting screws The signal supply main is generally run at the top of the poles consisting of two weather proofed insulated conductors spaced eight to ten inches apart by suitable insulators fixed to crossarms. The main signal cables are placed about three to four feet above formation level. This type of run is economical in some respect but unsightly in appearance.

When cables run on posts have to cross the tracks they are sometimes run into concrete troughing. This troughing is made in varying cross section and length and has a removable cover to permit inspection and for cleaning out the trough. Other fitments for concrete troughing include cornering, for changing direction, usually about 90 degrees and risers, for bringing the cable up from formation to cable run level. Concrete trunking is reinforced and strong enough to stand the

(*Continued on page 13*)

WORKSHOP FOR SMALL-SCALE INDUSTRIES TO BE SET UP IN DELHI

The Government of India have decided to set up a Prototype and Training Workshop for Small-Scale Industries, with financial and technical assistance from the Federal Republic of Germany.

The Workshop, which will be a multi-purpose project, will be set up close to the industrial estate at Okhla outside Delhi.

It will impart practical and theoretical training to workmen and technicians required to man small-scale industries as well as specialists to be attached to the Small Industries Service Institutes. These institutes have been set up by Government to provide technical guidance to small industries.

The Workshop will also develop special purpose machinery for the improvement of plant in small-scale enterprises and develop and build prototypes of machines, implements, components, etc. which are suitable for the use of small industries. The workshop may also execute job orders which cannot be carried out by small enterprises for some time to come.

In course of time, the prototype and training workshop will become a model for smaller training centres to be set up in different regions to meet the growing requirements of trained personnel for small industries.

This workshop will meet a long-felt need in the development of small industries in india because it will fulfil dual role of turning out skilled personnel and making prototypes of machines for small industries.

The German Government has offered to spend Rs. 50 lakhs on the project in the form of the plant and equipment required for the workshop and the services of a number of German experts for a period of three years. The rupee expenditure, to be met entirely by the Government of India, will be about Rs. 47 lakhs.

A delegation of Indian officials and experts is leaving for West Germany shortly where it will have discussions with representatives of the Federal Republic on the execution of the project. It will also visit German enterprises and study training methods followed at German Small Industries Training Centres.

The Delhi Prototype and Training Centre is expected to have a capacity to provide Training to 240 people. The different courses to be introduced will help to turn out 964 trainees every year.

EPOXY RESINS

(Contributed by: CIBA Dyes Private Ltd., Bombay)

THE epoxide resins which are available from CIBA under the name of 'Araldite' have, by reasons of their many outstanding properties, become well known during the comparatively few years in which they have been available. This is particularly true in the electrical engineering industries where these materials, in the form of adhesives and casting resins, have made possible the development of electrical equipment along lines not previously possible. Since their introduction, however, the resins which were originally available have themselves been developed to a considerable degree. Furthermore, in the years since their introduction, much has been learned of their behaviour, their properties and techniques of use. Originally there was only one type of casting resin, this being known as casting resin B, and this is still the type most widely used.

CASTING RESIN B

This is supplied in the form of lumps, golden yellow in colour, which are used with hardener 901, a white powder, both of which can be stored under normal conditions for periods up to two years. In use, the resin is heated to 120°-140°C., at which temperature it can be kept for several days without any deleterious effect. While at this temperature, 25-30 parts by weight of hardener 901 per 100 parts of resin are added to the resin and stirred in until it has melted. As soon as the hardener is added and providing that the temperature remains above 100°C., the process of curing begins and at 120°C. the pot life of the resin-hardener mix is between 1 and 1½ hours. Curing can be carried out at any temperature between 100°C. and 200°C., the times and temperatures being as follows :—

Temperature	(°F.)	392	346	310	274	238	212
	(°C.)	200	180	160	140	120	100
Curing Times	(hours)	1-2	2–3	5–7	7–10	10–14	14–20

The most suitable temperature for curing casting resin B is dependent upon the materials of the component which is being treated. In some instances, the maximum curing temperature will be dictated by one or more of the materials which are being encased, as several materials and pieces of equipment used in the electrical industries are not able to withstand very high temperatures. Apart from such considerations its is usually an advantage to cure at the lowest economic curing temperature. This particularly applies to very large castings where it is advisable to keep the temperature down in order to minimize the shrinkage due to the thermal linear coefficient of contraction. As will be seen from the properties listed in Table 2, the coefficient of expansion and contraction of casting resin B is about 60 parts per million but this may be reduced to about 25 parts per million by use of suitable inert fillers.

FILLERS

There is a large number of materials which may be used as fillers but these are not all equally suitable, as the percentage which the resin plus hardener will tolerate varies from 25 per cent to as high as 350 per cent. Among materials which have been tested are slate powder, mica dust, glass powder, quartz meal, sand and ground porcelain. Of these, it is found that sand of a type similar to that used in foundries can be used in the largest quantity but it is not necessarily the most suitable filler, as there is a tendency towards settling out during the curing process. The filler which offers the best all-round properties seems to be quartz meal of a particle size smaller than that which passes a 120 B.S.S. mesh sieve. Apart from reducing the thermal linear coefficient of expansion, the addition of fillers also provides the

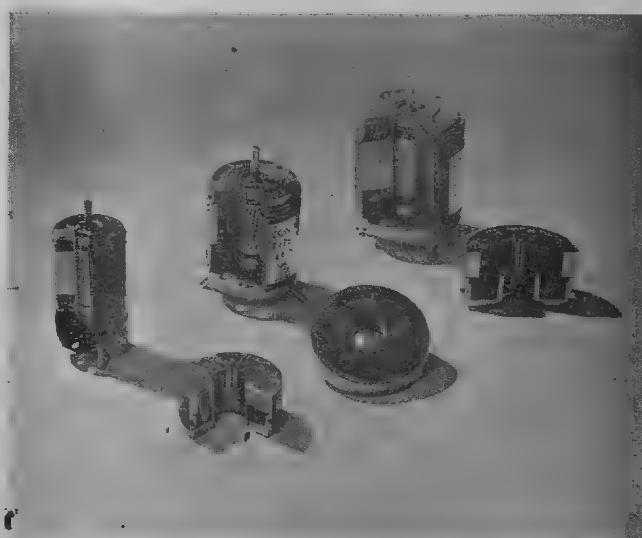


Fig 1. Servo motors. Laminations bonded with 'Araldite' 15, potted in 'Araldite' casting resin B.
(By courtesy of Kearfott Co., U. S. A.)

means of increasing the heat-conducting properties (see Table 2) and considerably reducing the cost of the resin mix, as these fillers are usually cheap.

MIXING OF FILLERS

When fillers are being used they have the effect of raising the viscosity of the mixture, and with most fillers it is the viscosity at pouring temperature which limits the amount of filler which may be added. The increase in viscosity means that there is a much greater possibility of any air which is entrapped in the mould being unable to escape, thus causing blow-holes in the final casting. In order to obviate this possibility, it is advisable to subject the resin and filler to heat (120°-140°C.) under vacuum before the hardener is added. The most satisfactory way is to treat these before mixing in order to pull off any moisture which may be present in the filler, and also any which may be on the surface of the casting resin. When these are then mixed together (which may be done out of the vacuum chamber) all that is left to pull off is any air which may be included in the mixing operation. For this purpose, about 20 minutes in vacuum of 1-2 mm. of mercury is recommended. The time may be easily judged, however, from the fact that when the vacuum reaches this level a rather violent movement may be observed in the resin-filler mix which will cause the mixture to rise to a height equal to about twice its normal depth in the container. When this has died down and the surface has become more or less still, the mixture may be removed from the vacuum chamber. If the mixture is not required for immediate use, it may be run off into trays and allowed to solidify, being subsequently broken up and stored. If required immediately, however, the correct quantity of hardener 901 should be added and, after stirring until the hardener has dissolved, the whole may again be subjected to a vacuum treatment. For this operation, a vacuum of 10 mm. is sufficient and this should be held for about ten minutes. Again a small movement occurs in the mixture but not as violent as that which takes place when the resin and filler are first subjected to vacuum.

CASTING

The mixture may then be removed from the vacuum chamber and poured into the moulds which have been previously prepared. Unless the shape of the mould is very complicated, further vacuum treatment should not be necessary, but where the conditions demand it, the filled mould should also be placed in the vacuum chamber at a temperature of about 120°C. and maintained under vacuum for about five minutes. The mould may then be transferred to an oven to complete the cure, or it may be allowed to cool and the resin cured at a later time.

TABLE 1

COMPARISON BETWEEN AVERAGE PHYSICAL PROPERTIES OF PORCELAIN AND CASTING RESIN B WITH 200 PER CENT. FILLER

	Porcelain.	*Casting Resin B + 200% Quartz Meal*
Specific gravity ..	2.6–2.8	1.7–1.8
Tensile strength ..	4,300–7,000 lb./sq. in.	10,500–12,000 lb./sq. in.
Compressive strength ..	57,000–64,000 ,,	28,000–31,000 ,,
Fatigue strength ..	8,500–11,000 ,,	17,000–20,000 ,,
Modulus of elasticity ..	$9–10 \times 10^6$	$1.7–2.0 \times 10^6$

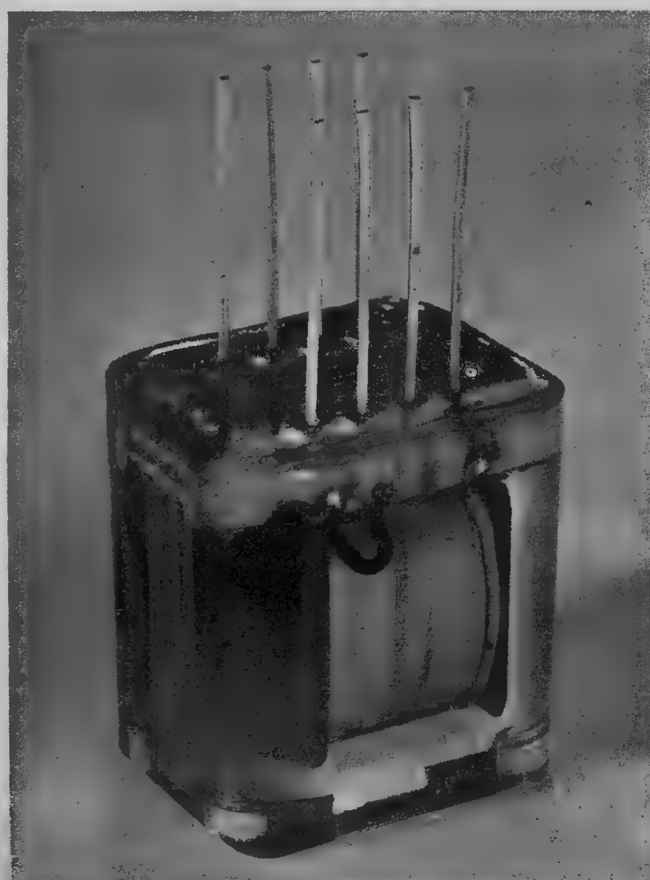


Fig. 2. Transformer potted in "Araldite" D. (By courtesy of Evershed & Vignoles Ltd.)

Such would be the technique used if curing were to be carried out overnight at a temperature of 100°C. which appears to be favoured by most manufacturers. As already mentioned, there are advantages in keeping the curing temperature down to 100°C., but in addition, electric power is sometimes cheaper during the night-time.

MOULDS

A wide variety of materials may be used for manufacturing moulds suitable for use with casting resins but, in general, it may be said that the simplest form of mould is usually the best. The design of a mould will obviously be dictated by the nature of the component being treated, but wherever possible sharp corners or sudden changes of section should be avoided. It has been found that aluminium alloys appear to be the most suitable materials from which to fabricate moulds, although steel is quite satisfactory and brass (sometimes chromium plated) is also used. 'Araldite' casting resins have excellent properties of adhesion to metals and it is necessary to use a parting compound to prevent the cured resin from adhering to the mould; the use of curing temperatures in excess of 100°C. rules out the use of most waxes. The parting agents recommended are those belonging to the silicone groups.

With a new mould it quite often happens that, when silicons greases are used, the first two or three castings produced in it do not free themselves very easily and it is therefore suggested that, before casting into a new mould, the process of applying the parting agent and curing is carried out with the mould empty. After this treatment it is usually found that separation of the mould and casting does not present any difficulty. It should be remembered, however, that the fact that the resin has a higher shrinkage rate than the mould material means that if cores are used when casting, they must be removed while the casting is still hot, otherwise their removal will be impossible due to the shrinkage of the resin on to the core.

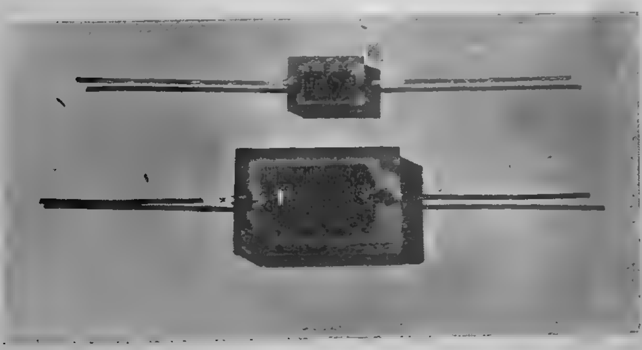


Fig. 3. Silver mica capacitors cast in "Araldite" casting resin "B"
(By courtesy of London Electric Mfg. Co, Ltd.)

If the mould is itself large, this should be heated to a temperature slightly higher than that of curing before the resin mix is poured. This prevents the resin mix from cooling, thus making the removal of any air bubbles present more difficult owing to the increase in viscosity of the mix. With sheet metal moulds, however, this is not necessary.

It sometimes happens that the number of castings of any particular shape which is required is very limited, and the cost of metal moulds is not justified. In such instances the use of moulds made from sand offers a convenient and economic method of producing the required casting. To produce sand moulds a wooden pattern is first made and around this is moulded the sand mixture. This is made by adding three parts by weight of resin 285 (CIBA), to 100 parts by weight of sand, mixing these, and stirring in four parts of water. It is sometimes an advantage to add one or two parts of Dextrine. This mixture, after moulding round the pattern, is baked for one or two hours at a temperature of 150°C. with the wooden pattern removed. In order to seal the pores of the sand mix, one and three parts of water and water glass respectively are brushed over the moulding surfaces a drying period being allowed between each coat.

USES OF CASTING RESIN B

The most extensive uses of casting resins are found in the electrical industries where the combined properties of adhesion, moisture resistance, mechanical strength, temperature and ageing resistance, combined with excellent electrical properties are employed to produce equipment which was not practicable until comparatively recent years. The properties of casting resin B are shown in Table 3 and it will be seen that the high strength of adhesion, coupled with good electrical insulation value, means that components may be satisfactorily joined together but at the same time be adequately insulated one from the other. This is particularly useful when it is desired to embed the windings of electric motors in which the encasing of the whole after winding prevents movements of the wires in subsequent use and at the same time insulates the windings. Among the types of component which are being manufactured with the aid of casting resins may be listed: transformers, bushings, capacitors, insulators, terminal blocks with cast-in terminals, resistors, bobbins, servo motors, transistors, relays and potentiometers.

TABLE 2

PHYSICAL PROPERTIES OF CASTING RESIN B, WITH AND WITHOUT FILLERS

	Test Method.	*Resin Mix 1.*	*Resin Mix 2.*	*Resin Mix 3.*	*Resin Mix 4.*	*Unit.*
Approx. adhesive strength (bonding Avianel M)	—	2,900–3,750	2,000–2,700	2,550–2,900	1,150–2,500	lb./ sq. in.
Ash content	—	0.02–0.03	15–16	60–61	69–70	per cent
Combustibility	—	5–10	8–10	8–10	8–10	seconds
Compressive strength	ASTM D695–49T	15,500–18,500	17,000–18,500	28,000–31,000	206,000–220,000	lb./sq. in.
Decomposition	—	340–360	335–345	340–345	345–350	°C
Fatigue strength	VM77103	12,700–17,000	9,000–11,300	17,000–20,000	7,100–8,500	lb./sq. in.
Flexural strength	ASTM D790–49T Schopper test bar 120×15×10 mm.	12,800–17,000	9,300–11,400	10,000–14,000	7,000–8,500	lb./sq. in.
Heat resistance (Marten's test)	Federal L–P–406a–2011	105–115	110–120	120–125	125–130	°C
Modulus of elasticity	ASTM D638–46T	$0.42–0.57 \times 10^6$	$0.64–0.78 \times 10^6$	$1.7–2.0 \times 10^6$	$2.1–2.6 \times 10^6$	lb./sq. in.
Shrinkage (depending on curing temperature)	—	0.5–2.5	—	—	—	per cent
Specific gravity	—	1.2–1.3	1.25–1.35	1.7–1.8	1.9–2.0	—
Tensile strength	ASTM D651–48	8,500–11,000	9,000–11,000	10,500–12,000	5,000–5,600	lb./sq. in.
Thermal conductivity	—	approx. 0.17 „ 0.008	—	approx. 0.54 „ 0.036	approx. 0.73 „ 0.036	kcal/m^c h°C. watts/ich^2/°C.in.
Thermal coefficient of linear expansion	ASTM D696–44	$60–65 \times 10^{-6}$	60×10^{-6}	$30–35 \times 10^{-6}$	$25–30 \times 10^{-6}$	parts per million per °C.
Water absorption, 10 days at 20°C	ASTM D570–42	0.25–0.35	0.25–0.35	0.25–0.3	0.15–0.2	per cent weight
1 hour at 100°C	—	0.3–0.45	0.3 –0.4	0.3 –0.45	0.2 –0.3	„ „
Composition of Resin Mix						
'Araldite' Casting Resin B	—	100	100	100	100	parts by weight
Hardener 901	—	25–30	30	30	30	„ „
Filler	—	—	25 slate powder	200 quartz or porcelain flour	300 quartz sand	„ „

One development which appears to be gaining ground rapidly is the production of insulators from casting resin B plus silica, as a substitute for porcelain insulators. Table 1 gives a direct comparison between the properties of each type of insulator and it will be seen that the advantages generally lie with the insulator made from casting resin.

Any metal fittings required, which normally have to be attached to the porcelain, may be cast *in situ*, and due to the adhesion of the casting resin to the metal, freedom from electrical interference is obtained. Furthermore, the dimensional accuracy possible with casting resin is of the order of 0.1-0.2 per cent as compared with the normal variation of five per cent which is found in ceramics. Possibly the greatest advantage, however, is the resistance of the casting resin insulator to thermal and physical shock. Filled resin castings may be repeatedly dropped on to a concrete or stone floor without causing any damage other than possibly chipping the outside surface, whenever a protrusion or edge hits the floor at an awkward angle. Such castings may also be heated to temperatures of 100°C. or more and plunged straight into cold water many times before showing any signs of cracks. The dielectric constant of the cast insulator is usually better than that to the ceramic insulator and the electrial breakdown strength is practically the same.

The largest users of casting resin B are transformer manufacturers and it has been found that a potted transformer offers many advantages over the conventional oil-immersed transformer. Among these advantages is the facility it affords for designing a transformer of a given capacity which is considerably smaller in bulk and consequently lighter in weight. Insulation resistance is also higher than the of a taped transformer and heat transfer compares very favourably with that of an oil-filled transformer. Possibly the most important factor, however, is that transformers potted in resin will satisfactorily withstand the full tropical tests laid down by Service standards and are not likely to catch fire if overheated. Many other items of electrical equipment are also being encased in resin in order to meet the requirements of tropical conditions.

NEW CASTING RESINS

As mentioned earlier, since casting resin B was introduced, much development work has taken place and several other types of 'Araldite' resins are now offered which are of particular interest to the electrical engineer. These new products all adhere strongly to metals and may be listed as follows :

1. Casting resin type D
2. Casting resin type F
3. Flexible casting resin
4. Impregnating resin

CASTING RESIN D

This is a cold-setting resin used in conjunction with hardener 951, both of which are solvent-free liquids. In use, ten parts by weight of resin D are mixed with one part by weight of hardener 951 (nine parts by volume of resin D with one part by volume of hardener 951) and thoroughly mixed together. The mixing is of great importance, as, unless this is complete, free hardener will remain in the resin with the result that complete hardening will not take place ; there is the further danger that free hardener may cause corrosion of copper or brass. When mixed correctly there is no danger of corrosive action and should this occur it is a sign of faulty mixing. It has been found that the most suitable and possibly the easiest way of mixing these materials is by means of on electric-vibrator mixer working at a frequency of 60 cycles per second. By such means it is possible to mix about 2 lb. of resin and hardener in about two minutes (by other means at least 15 minutes would be required for this amount) and with this method of mixing, air is not added to the mixture. When the hardener has been added an exothermic reaction occurs and for this reason it is recommended that the quantity mixed should be kept to a minimum and that the container used for mixing should be made of a material which

Fig. 4. Pulse Transformer embedded in 'Araldite' casting resin 'B'
(By courtesy of Aircraft Transformer Co., U.S.A.)

TABLE 3

ELECTRICAL PROPERTIES OF ARALDITE CASTING RESINS

	Test Method	*Casting Resin B*	*Casting Resin D*	*Unit*
Permitivity or dielectric constant	ASTM D150-47T			
60 c/s		3.8		
10r c/s		3.65		
10r c/s		3.62	3.76	
2∫10r c/s		3.09		
10rr c/s		3.01		
Loss angle tan δ	ASTM D150-47T			
60 c/s		0.0017	0.015	
10r c/s		0.0024		
10r c/s		0.019		
3∫10r c/s		0.027		
10rr c/s		0.022		
Dielectric strength (*d* in.)	ASTM D149-44	400		volts/mil
Diffusion constant	ASTM D697-42T	1.0	1.1	
Surface resistivity	ASTM D257-49T	$>3.8\times10^{13}$		ohms
Volume resistivity	ASTM D257-49T	$>10^{15}$	6×10^{14}	ohms
Arc resistance time	ASTM D495-8T	50-180		seconds

will enable the heat generated to be dispersed as quickly as possible. It is helpful if the container is of such dimensions that the depth of resin is small. It is possible to control the exotherm by maintaining the resin and hardener at a low temperature, say 5°C., before mixing. They should also be kept at this temperature immediately after mixing and poured into a cold mould. By regulating the rate of temperature rise of the mould and resin the exotherm may be controlled. After such treatment it is essential to post-cure at a temperature of between 80° and 100°C. for about two hours in order to develop fully the properties of the resin.

Fig. 5. Valve for chemical plant cast in 'Araldite' casting resin B. The bore of the valve is 4 in.

After the hardener is added the mixture remains pourable for 1½ hours at normal room temperatures (or considerably longer at lower temperatures) after which time setting takes place. Full curing, however, takes at least 24—36 hours at room temperatures but after about five hours the resin has set sufficiently to enable the casting to be removed from the mould. Although this is essentially a cold-setting resin, the curing process may be accelerated by means of heating, which also has the advantage of improving the physical properties of the cured resin.

The electrical characteristics of type D are similar to those of casting resin B up to about 60°C. but its heat resistance is lower and it softens at temperatures above 50°—60°C. It is less water resistant, but samples have satisfactorily withstood tropical test.

CASTING RESIN F

Casting resin F, which is a solvent-free liquid resin of fairly high viscosity, may, unlike the casting resins already mentioned, be employed as a cold-setting resin using hardener 951, or as a hot-setting resin using hardener 901.

TABLE 4

CHEMICAL RESISTANCE OF 'ARALDITE' CASTING RESIN B

Test Medium	*Concentration*	*Temp. °C.*	*Resistance*	*Duration of Test*
Acetone ..	100%	20	N.R.	
Benzene ..	100	20	R	6 months
	100	80	R	6 months
Distilled water ..	—	20	R	12 months
		100	L.R.	3 months
Ethyl alcohol ..	100	20	R	6 months
	100	80	N.R.	
Formic acid ..	100	20	R	6 months
Glacial acetic acid ..	100	20	R	6 months
Hydrofluoric acid ..	100	20	R	
Hydrochloric acid ..	10	20	R	6 months
	10	100	R	6 months
	100	20	R	6 months
Nitric acid ..	100	20	N.R.	
Potassium permanganate ..	6g/100g water	20	R	3 months
Oil (mineral) ..	100	20	R	12 months
Sodium chloride ..	1	20	R	6 months
Sulphuric acid ..	10	20	R	6 months
	50	20	R	6 months
	96	20	N.R.	6 months
Trichlorethylene ..	100	20	N.R.	

N.R. Not resistant. R. Resistant. L.R. Limited resistance.

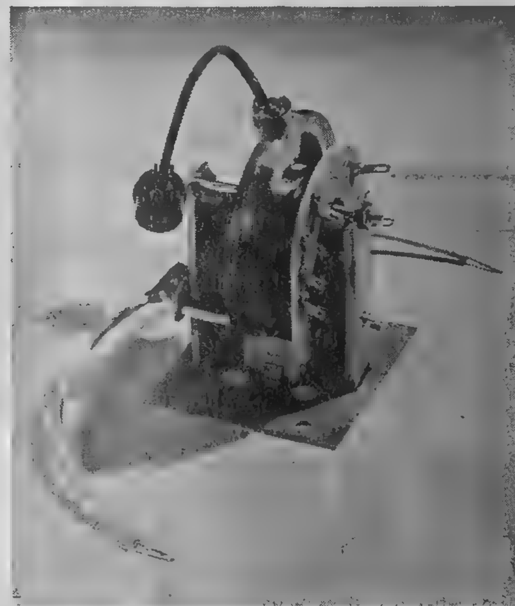


Fig. 6. Fly back transformer, potted in 'Araldite' casting resin B (By courtesy of Todd-Tran. Corporation, U.S.A.)

When used with hardener 951, 10—12 parts by weight of hardener are added to 100 parts by weight of casting resin F. As with casting resin D, there is an exothermic reaction and large amounts should not be mixed. At normal temperatures the pot life of the resin hardener mix is about 45 minutes and setting time is about 24 hours at 20°C. As with casting resin D, the application of heat will shorten the setting time, the times and temperatures being as for casting resin D.

As a hot setting casting resin using 40—45 parts by weight of hardener 901 to 100 parts by weight of casting resin F, a liquid of low viscosity at 100°C. is produced. At this temperature the pot life is over four hours. Due to the very low viscosity of this mixture and the fact that it does not contain any solvents, it is particularly suitable for the embedding and impregnation of very fine windings. A double process is recommended for the potting of finely wound parts, consisting of an initial impregnation using casting resin F with hardener 901, and after curing, the impregnated winding is potted in casting resin B and silica sand. This technique permits the use of the most suitable resin for each purpose.

FLEXIBLE CASTING RESIN

Although casting resin B meets the requirements of most users and is in fact used for potting current transformers which embody as much as 2600 lb. of resin, it was felt that there was a need for a flexible casting resin which would retain its flexibility throughout the recommended temperature range of the resin. Furthermore, as it is not practicable for the resin manufacturer to know the degree of flexibility required for each component, it seemed advisable that the resin should be so made that the user could vary the degree of flexibility by varying the proportions of the component which imparts the flexibility.

IMPREGNATING RESIN

Although casting resin F, when used with hardener 901, is of such a viscosity that it is suitable as an impregnating resin, it suffers from the disadvantage of a relatively short pot life and must be handled at an elevated temperature. In order to overcome these difficulties new impregnating resins, which have a long pot life, have now been developed.

It should be noted that 'Araldite' resins, particularly casting resins, possess properties which are of great interest to the chemical engineer as well as the electrical engineer.

Table 4 shows the chemical resistance of casting resin B, which is already being used very extensively for making valves, taps, etc.; the fact that it machines very easily increases its usefulness.

From these notes it will be seen that the development of the range of epoxy resins is now taking place at a fairly rapid rate. In addition to the materials already mentioned several other products are now undergoing tests before being offered to industry.

(By courtesy: JOIE, Bombay.)

FIRST EXPORT OF INDIAN IRON ORE

Shri N. Kanungo, Minister for Commerce, Government of India is reported to have disclosed recently in the Parliament that India, for the first time in 1875-76 exported five tons of Indian iron ore valued at Rs. 100. As against this, total export of this ore last year amounted to 1.793 million tons.

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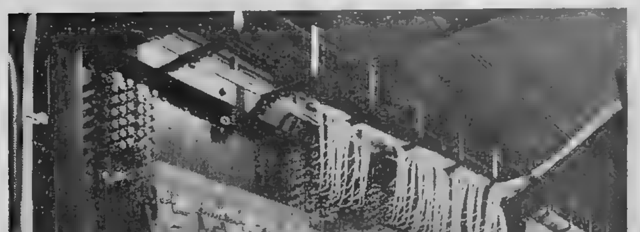
ordinary wear and tear of the permanent way. It is not affected by damp or termites the two chief reasons for not using wood.

LOCATIONS

In most signalling schemes there are a number of track circuits situated too far from the signal box to have the track relay placed there. It is necessary to house the track relay at the track circuit and use a track repeater relay, operated by the track relay, in the signal box. In the case of railways with four or more tracks there may be quite a number of track relays to house at one place. In earlier works each relay was accommodated in its own individual cast iron case. The appearance of a number of these cases can be seen in the accompanying photograph. If the lids are not distinctly marked with the designation of their contents, the signal lineman may lose time when tracing a fault. A much more convenient arrangement is to place all the relays, fuses, etc. in a cubicle or location case. The railway on which the writer was Chief Signal Engineer used brick cubicles manufactured by the Signal Department staff. These brick cubicles had a corrugated asbestos roof and teakwood doors with asbestos panels. The cubicle was constructed on a substantial concrete base wide enough for staff to stand on when the doors were open. The corrugated roof was also large enough to extend over this space and thereby shelter the staff, and the apparatus, during heavy rain. This is not the case with individual, cast iron relay boxes which give no protection at all from rain once the cover is removed. The inside of the cubicle was fitted with a steel framework provided with shelves for supporting track relays and other equipment with a framework at one side for the fuse bases, terminal blocks etc. the cable terminations being made at this point. The wiring diagram of the location, position of fuses etc. was fixed inside one of the doors and suitably protected from damage. This form of construction was found very suitable for tropical climate for the combination of asbestos roofing and brick sides kept the apparatus cool. The over-



Rack of plug in relays in signal box relay room.
(British Railways)

Fuse board and plug in relays in signal box relay room.
(British Railways)

Cable termination board and terminal blocks in signal box relay room. (British Railways)

hanging roof also sheltered maintenance personnel from sun and rain in the monsoon season. The cost of these cubicles was much less than a steel location case.

There are instances where the signals at manually worked signal boxes were converted to multi-aspect colour light signals with track circuiting. The points continued to be worked manually by means of rodding. The basement of a mechanical signal box is not very suitable for accommodating electrical signalling equipment and in such case a small cubicle or relay room, of the same brick and asbestos construction, was built on the outside of one of the signal box walls.

Electrical developments in this country and overseas have made such progress in recent years that it is hardly possible to find a place where an electrical supply is not available. On overseas railways there are, however many stations where electrical signalling plants have to be powered from primary batteries. Some types of batteries require periodical cleaning and changing of the electrolyte. This work is best done outside the signal box basement and for this reason the same type of brick cubicle were used for battery accommodation and were very successful.

An alternative to the locally constructed brick cubicle is the sheet steel location case which is supplied in several sizes. These cases are fitted to an individual railway's requirements and can be used as cable junction points, distribution points and also accommodate relays, local transformers and rectifiers, batteries etc.

A location case is positioned close to a group of signals, points, track circuits or other functions. Separate cables are run from the location to the function but they all join the main cable terminating or looping into the case. For example, two 61 core cables run from the signal box to the first location case. Here wires have to be distributed to two multi-aspect signals, a pair of points and two track circuits requiring probably 17 wires in all. These were contained in one of the 61 core cables which continues to the next location case as a 48 core cable, the next standard size. The 17 wires are connected to the functions concerned by short lengths of 3, 5 or 7 core cable, as required. The connections to track circuits is by means of single wire and is of necessity of heavier section than the cable cores. Four wires are attached to the running rails, two at each end of the track circuit. These wires are subjected to heavy vibration and have to be flexible and heavily insulated. A 7/,029 wire is a fairly standard section and this is protected by insulation in accordance with the requirements of the British Standard Specification for signal cables. The single wires are run direct from the running rails to the terminals in the location case. The number and size of cables between location cases diminishes as the distance from the case to the signal box, increases. The first location case attached to the signal box, and farthest from it, may have only a 7 core cable running from it to the next case. Here the size of the cable running from the second to the third case changes from 7 core to 19 core and so on. The cables connecting the last location case, or cases, to the signal box, may be as many as five or six 61 core cables.

The number of cables cores terminating in a signal box relay room depends on the size of the installation and may be from several hundred to several thousand. The great increase in the number of wires has made original methods obsolete and at the present time the normal way is to terminate cables on to fuses or terminal blocks fixed to open racks. The racks are made of steel, fixed to the wall of the relay room, with the terminal blocks screwed to verticle steel strips.

The cables enter the relay room by means of an open trough at floor level. The cores are separated, taped and suitably finished and attached to the terminals on the blocks.

Several ways have been used for labelling wire terminations. One method is to fix an engraved label against the terminal block or fuse at the junction point between inside and outside wiring or to paint the designation on a wooden strip. If the wire has to be disconnected during alterations or other work, it has to be specially labelled. For this reason some railways use a sleeve, with the wire designation stamped on it, slipped over the wire and this seems to be the safest method.

CONNECTIONS BETWEEN SIGNALLING AND INTERLOCKING RELAYS

The Underground's extension and modernisation programme, which began in 1923, brought with it a large number of new signal boxes and although power level frames were in vogue at that time, the interior arrangements of the signal boxes, particularly with regard to the relays and wiring, were entirely different to their predecessors. Access to the bottom portion of the older power frames was obtained by removing the side, back or front panels. The connections to the lever contacts and lever locks were not easily accessable and illumination was supplied by means of an inspection lamp. The wiring between the lever frame and the cabinet containing the relays was run in wooden trunking.

The floor of the upper portion of the new signal cabins had a rectangular opening constructed in them which exactly fitted the area covered by the power frame. The relays were placed on open shelves, fixed to angle iron racks, and these were arranged around the opening in the relay room ceiling and signal box floor in the form of a square U. A steel platform ran the whole length of the opening, a few feet below the ceiling and access to this was obtained by a steel ladder. By this means the whole interior of the power frame could by inspected with great ease by the signal maintenance man mounting the ladder and standing on the platform. Fixed lights illuminated the interior of the power frame. The various relays being arranged around the floor opening considerably shortened the amount of wiring necessary. This was run on the open system being neatly treed and supported by aluminium hooks.

In modern signalling, relays have to accommodate many wires. If a relay becomes defective it has to be changed necessitating the removal of the wires and their correct replacement. The task is simplified if the wires are already labelled but the process is a length one and great care and attention is essential. When the work is completed all the circuits affected have to be tested to ensure that wires have not become accidentally changed. A relay failure on a busy suburban section can cause severe dislocation of traffic and it has to be changed as quickly as possible. The maintenance personnel who have to change the relay are naturally all too conscious of the necessity for speed and it is this factor that could cause wires to be inadvertantly exchanged. The facility for testing all the circuits involved after the work is completely is not immediately available with trains running at close intervals. This very real problem led to the development of the detachable top relay. This relay has two tops, one permanently fixed to the relay case with its terminals connected to the contacts, coils, etc. The removable top has the terminals to which the outside wiring is secured. The two tops are clipped together by a special locking device which brings the underside of the terminals and the contact pieces leading to the interior of the relay together. Once the relay is connected up it is unnecessary to disconnect it again when it has to be changed. When a relay has to be

Steel location case showing terminals, fuses and plug in relays. (at top)

ANNOUNCEMENT

We have pleasure in announcing to all our Readers and Advertisers that we propose to bring out a special Number to our Magazine entitled "EIGHTH ANNIVERSARY TRANSPORT & ENGINEERING" sometime in January 1958.

EDITOR.

changed, the locking device is opened and the terminal top is lifted off with the wires for the various circuits attached to it. Hooks are provided on the underside of the relay shelf immediately above and they support the terminal top while the relay is being changed. Not only does this mean that the changeover can be done very quickly but there is no likelihood of wires becoming crossed. To prevent the wrong type of relay being used in place of the one being removed, each relay has one or two sets of code pins. If a relay of another type, with different contact arrangements and characteristics is substituted, the terminal board cannot be fitted to it. A difficulty with the detachable top arises with the wiring. If this is run flat across the terminal top and treed where they leave the relay, some resistance is experienced when lifting up the top. Some railways attach the wires singly and vertically each one going through a hole in a guide board into the wire run over the relay.

PLUG IN APPARATUS

Another type of signal relay which has become very popular is the plug in type. These relays are plugged into a plugboard which has terminals at the back. The plugboards are mounted on verticle racks. Connections from the relay are run out through the base as springs which engage on contact strips on the side of wedges composed of insulating material on the plug base. Each relay is supported by two brass rods projecting from the plugboard and these act as guides. The relay is pushed right home and secured in position by two knurled nuts. A relay can be changed in a very short time and a dexterous man can do it in about 30 seconds. The wiring between the plugboard terminals is arranged in the same manner as the earlier type relays and the wiring from the relay rack is taken across to the cable terminal rack or control unit at suitable positions through overhead steel channels. Inadvertent use of the wrong type of relay is checked by coding pins as with the detachable top type.

Rear view of upper portion of location case showing rear view of relay plugboards.

In another type of plug in relay, the plugboard is not provided with terminals but with detachable terminal spades or contact pieces to which the connecting wires between relays are soldered. When it is necessary to remove a wire from a relay, the detachable terminal spade, which is locked in position at the back of the plugboard, is withdrawn by means of a special tool. If wiring alterations are necessary at any time, new wires can be run with the terminal spades already attached ready for exchanging or for insertion in new positions. The main feature of the detachable terminal spade in the relay plugboards is that disconnection points are available without the necessity for providing independent terminal boards for each relay. Special arrangements are also made to permit a Voltmeter or an ammeter to be connected in circuit without interfering with the operation of the relay in any way.

Plug in equipment is also used for outdoor apparatus. The plugboards are mounted on a framework fitted inside the location cases and the method of changing relays is exactly the same as in the signal box relay room. Quickly detachable plug coupler arrangements are also provided for the electrical movement and connections in searchlight signals.

PREWIRED APPARATUS

In order to reduce the amount of wiring required to be done at site, signal cabin relay racks and location cases for the main cable run can be prewired by the manufacturers or in the railway's signal shops. Not only does this save work out on the track but it permits the work to be done more neatly and accurately. The only wiring to be done outside is that of connecting the main cables to the location cases, the incoming cable to the fuse and terminal racks in the signal box relay room and the wiring between one relay rack and another or to the control unit.

In new construction work now being carried out, both at home and abroad, and in work still in the planning stage, quickly detachable, plug in facilities will be required for almost all types of apparatus to be used. Whole units will be manufactured assembled and prewired in the workshops with the object of cutting down the amount of wiring on installation work to a very minimum.

SOUTHERN RAILWAYS MAGAZINE

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ALLOYS, FERROUS & NON-FERROUS METALS SUPPLEMENT

CONTENTS

Now Routinely-Travelled Tunnel under New York's Hudson River has Romance, Drama in History

ONE of the oddities of New York, the world's most heavily-populated city, is that its largest suburb is separated from it by a two mile-wide river and a state boundary line.

Daily, a million or more people must travel by boat, bridge and tunnel across the Hudson River from the northern section of the state of New Jersey to man the factories, stores and office buildings of New York, Globe Press Service reports.

A good portion of this group travels on the Hudson and Manhattan Railroad which fords the river through dug beneath it.

Modern rapid transit cars can make the trip in a few minutes. And, the Railroad has just announced that it is buying 50 of the most modern with high-speed, light-weight propulsion equipment built by General Electric (U. S. A.). The cars will be capable of rapid acceleration and braking, and have such conveniences as air conditioning, picture windows, light-weight steel bodies and insulated floors covered with asbestos tile to reduce vibration and noise.

In short, travel beneath New York's Hudson River is up-to-date, modern, common place. Passengers ride the trains without a thought to the fact that, at some points, they are over 100 feet below the surface of the river.

Such was not the case, however, in 1908, when the first under-river tunnel was completed. It was, according to the New York Times of that year, "conceded to be one of the greatest engineering feats ever accomplished; greater even than perhaps the Panama Canal."

Thirty-four years of work had gone into the construction of the first river tunnel—an era of engineering heartbreak, financial discouragement, disaster and delay.

It was begun in November, 1874, by a man named DeWitt C. Haskin. Haskin started excavating a 6.0-foot deep shaft for the tunnel on the New Jersey side at a time when the project was universally regarded as impossible.

On July 19, 1909, after 34-years of oft-interrupted work, two tunnels were completed beneath the Hudson River, situated as shown in this artist's sketch circa 1910. Today, modern high-speed electrified railway cars, powered by General Electric (U.S.A.) drive, make the three-mile under-river trip in a matter of minutes. General Electric recently announced that it is building more traction equipment for 50 additional high-speed cars, which will be among the most modern in existence, featuring air conditioning, picture windows, light-weight steel bodies and insulated floors covered with asbestos tile to reduce vibration and noise.

—GLOBE PRESS SERVICE

Initially, it seemed as if the skeptics were right. Work was halted during Haskin's first year of operation because of financial difficulties.

The bottom of the river, engineers discovered, is composed of fine mud and silt, soft enough when permeated by water to flow through the smallest opening and so unstable as to offer precarious support, at best, to a tunnel.

In addition, on the New York side of the site selected, a rock ledge projects up to near the river bottom and any tunnel had to pass partly through this rock with its upper edge in the treacherous silt—a condition never before encountered in under-water tunnel work.

Under these conditions, Haskin's original plan to line the tunnel with brick would surely have proved unworkable, even had he been able to continue.

Five years went by before construction of the shaft was resumed. It was finished in November, 1879, and the lateral penetration for the tunnel began.

Within a year, work has halted again—this time by disaster.

While trying to enlarge the juncture between the shaft and the tunnel, there occurred what is most feared by "sandhogs," as the men who worked on underwater construction were called—a "blowout."

Pictured is the shielded main tunnel built for the Hudson & Manhattan Railway. As work progressed, the forward wall of the tunnel was pushed ahead and sealed to prevent the encroachments of water which, in one disaster, claimed twenty lives. Under the final arrangements of the tunnel, the original plan to line the tunnel with brick was scrapped in favor of curved steel plating shown here.

—GLOBE PRESS SERVICE

A large section of the tunnel ceiling was crushed under the pressure of the water above and the river poured in. Twenty workmen were trapped and killed and for each of these workmen, a year passed, as if in memoriam, with no further progress on the dream of a tunnel beneath the Hudson River.

In 1899, the project was sold under foreclosure.

There finally appeared on the scene in 1902 a man who felt the tunnel could be completed. His name was William Gibbs McAdoo and he convinced financiers that the tunnel could not only be finished, but opened and operated at a profit. So powerful were his arguments, he gained backing from them.

McAdoo, then president of the Hudson and Manhattan Railroad Company, put the company's chief engineer, Charles M. Jacobs, in charge of the project. Jacobs approached the job with greater skill and more modern methods.

He proposed to line the tunnel with cast iron and push shielding ahead of the construction workers to prevent flooding. Before starting, however, he first had to pump the water-filled tunnel dry.

With the renewed interest, work moved ahead quickly and a second tunnel was started even before the first was finished in 1908.

The celebration that attended the opening of the first tunnel on February 25 of that year was nothing short of sensational.

The tunnel was three miles long and reduced travelling time between New York and New Jersey from 45 minutes by motor car and ferry to 15 minutes by train.

Thousands waited in line from 9 a. m. the previous morning in order to get the first ride under the river. First in line was a young girl, Barbara Schlatter, from Hoboken, New Jersey. She and the others had waited all day in the snow.

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METALS SUPPLEMENT

"Alloys for High Temperature Service"

*By *Dr. D. Swarup,* B. Sc. (Met), Ph. D. (Sheffield), F. I. M.

THE phenomenal development witnessed in recent years, in the production of jet engines, gas turbines and the various types of rockets has exerted a tremendous influence in the evolution of many alloys suitable for service at high temperatures. The efficiency of a gas turbine is, among other factors, a function of operating temperature and so is the case with the internal combustion engine components which are subjected severe service conditions—particularly alternating stresses at elevated temperatures. It has been said that the possibility of jet propulsion arises mainly out of the development of alloys capable of functioning at high temperatures. It is proposed to deal with some of these developments briefly in this paper.

HIGH TEMPERATURE ALLOYS

It may be admitted at once that the theoretical principles of alloy making have not advanced to that stage at which, given the requirements, one can prescribe a suitable composition and a thermal treatment. Constitutional diagrams of binary alloys are available for almost all the useful metallic elements, as well as a few ternary diagrams. These and the properties of the pure metals offer some guidance, but the majority of industrial alloys are complex systems and the behaviour of these under a set of conditions cannot be reliably forecast. The development of alloys, therefore, is largely empirical and suitability has often to be decided by service tests. Inspite of these difficulties, quite a number of alloys have been developed. It has been said that " alloys and steels used in modern jet engines (which are of course only one application of the gas turbine engine) have to withstand stresses equivalent to hanging two saloon cars from a red hot piece of metal about the thickness of a fountain pen, without stretching or distorting it. They have in fact, to withstand 10 tons per sq. in. at 850 deg. C. Moreover, conditions in the engine are such that the fountain pen might have to be red hot at each end and comparatively cool at the centre. The necessity for meeting demands of this sort has led the steel industry's scientists into some unusual paths."

The high temperature alloys for use above 600–650°C have an austenitic matrix and several types are found. A few of these are:—

(i) Stainless steel type, which are essentially of Fe–Cr–Ni base. Timken 16 — 25 -6 and 19 — 9 DL belong to this class.

(ii) Stellite type alloys, which are essentially Co–Cr–Mo or Co–Cr–W base. Vitallium and Jessop G–32 are representatives of this class.

(iii) Inconel or chromel or nichrome type. These are essentially Ni–Cr alloys made hardenable by alloy additions such as Ti. Inconel -X, Nimonic 80 etc. typify this class.

There are other types which are modifications of the above. The evolution of a creep resisting alloy 'Cromadur' in place of 'Tinidur' is a notable development of the last war. Tinidur is an austenitic alloy containing 30% nickel. Shortage of nickel in Germany necessitated its replacement by manganese and the alloy 'Cromadur' was developed. The composition of some these alloys is given in Table I.

The use of non-metallic materials (Ceramics) along with creep-resistant metallic powders which are pressed and sintered under appropriate conditions, is yet another field of research. These ceramic—bonded metal parts are more resistant to thermal and mechanical shock than ceramic materials, but they present many new problems as they are relatively brittle and the method of bonding is far from satisfactory.

In high-temperature operation, the behaviour of metallic parts depends more upon their plastic properties

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TABLE I – HEAT RESISTING ALLOYS.

Sl. No.	Type.	Ni	Cr	Mo	W	Cb	Ti	Other Elements	Remarks.
1	Cr-Ni-Fe	8	18	0.4 to 3.0	1 to 3	0.3	0.2 to 1.5	Balance Fe	
2	Ni-Cr-Fe	20 to 50	14 to 25	4 to 14	Upto 4	Upto 4.2		Balance Fe	e. g., Timken Cr/Ni/Mo : 16/25/6
	Refractaloy A	50	20	14	—	—	—	Balance Fe	
3	Ni-Cr-Co-Fe	15 to 33	14 to 27	3 to 10	Upto 4	Upto 4		Co 13 to 45 N_2,B,Ta Balance Fe	
4	Ni-base : Hastelloy	B 65	—	29	—	—	—	Fe 5	Forged buckets for use under 1400°F.
5	Ni-Cr & Ni-Cr-Co	37 to 75,	14 to 22	—	—	—	—	Co Upto 22	Hardened by Al or Ti
	"Nimonic 80"	74	22	—	—	—	2.5	Al 0.6	
6	Co-Cr :–Vitallium	—	28	5.6	—	—	—	Balance Co	Precision cast buckets.
7	Co-Cr-Ni	10 to 32,	23 to 25	Upto 6	Upto 12	—	—	Balance Co	
8	Cromadur	—	12	—	—	—	—	Mn-18 V-0.7	

than upon the elastic properties which dominate their behaviour at low temperatures. The plastic properties are more difficult to characterize, since the plastic deformations are not proportional to the applied loads. In the high temperature range, a part may creep under constant load so that in time the plastic deformation much exceeds the elastic strain. The tendency of the part to flow, the deformation continuously increasing in time, is a high temperature property of immediate concern to design engineers. Metallurgists recognize additional properties necessary to successful operation at high temperature. These properties are listed in Table II.

Table II. High Temperature Properties.

1. Chemical composition.
2. Processing data.
3. Room temperature properties compared to high temperature properties.
4. Short time tensile strength.
5. Stress rupture strength.
6. Creep strength.
7. Design data.
8. Hot impact strength.
9. Hot fatigue strength.
10. Change in the elastic constants with temperature.
11. Change in the coefficients of thermal expansion.
12. Change in the thermal conductivity.
13. Hot hardness.
14. Relaxation tests.
15. Influence of combined stresses.

HIGH TEMPERATURE TESTS

The testing of these alloys includes high temperature creep and rupture tests. Some figures of the former are given in Table III which is self-explanatory.

Table III.—Stress-Rupture Tests at 1500°F.

S. No. Material	Stress for rupture in thousands of lbs. per sq. inch in 10 hours.	100 hours.	500 hours.
1. Cr-Ni-Fe	12.5 to 22	11 to 16	10 to 11
2. Ni-Cr-Fe	17 to 22.5	10.5 to 18	8.5 to 12.5
3. Ni-Cr-Co-Fe	20.5 to 34	16 to 25	12.5 to 20
4. Ni-base	25	15 to 17	11.7
5. Ni-Cr & N Ni-Cr-Co-Fe (Ti & Al hardened)	21 to 40	13 to 29	17 to 21
6. Co-Cr	21	11 to 28	14 to 25
7. Co-Cr-Ni	25 to 33	27 to 30	24 to 27

Since most of the components out of these alloys are to be manufactured to very close tolerances for interchangeability, as well as for considerations of high operating efficiency, dimensional changes under working conditions and during the working life have to be known before hand. Creep tests are used for this assessment which measure the deformation in terms of the stress in lbs. per sq. in. required at a particular temperature to cause a creep rate of one-ten millionth of an inch per hour for every inch of the length of the specimen. It may be mentioned that the average working life of an aero-engine is about 300 hrs. and that of an industrial unit is about 100,000 hrs. (11 years). The figures given in Table IV are indicative only of the magnitude of the creep.

Table IV—Some Creep Data of High Temperature Alloys.
Temp. 1350°F.: Stress 15,000 lbs./Sq. in.

Sl. No.	Material and Treatment	Creep rate per hr. @ 1000 hrs.
1.	Cr-Ni-Fe: C. O. 26, Cr. 18, Ni. 8. (Oil-quenched & aged)	0.00004
2	Ni-Cr-Fe: C. O. 4, Cr. 13, Ni. 19, Mo. 4.28, W. 3.87, Cb. 4.2. (Water-quenched and aged)	0.000101
3.	Ni.-Cr-Co-Fe: Refractaloy M 284 C. O. 11, Cr. 20, Ni. 20, Co. 30, Mo. 8, W. 4 (Oil-quenched and aged)	0.000052
4.	Ni-Cr-Co-Fe: (Ti and Al hardened) Refractaloy 26. C.O.03, Cr.18, Ni.37, Co.20, Mo. 3, Ti. 3, Al. O. 25 (Oil-quenched & aged)	0.00001
5.	Co-Cr:—Vitallium C.O. 2, Cr. 28, Mo. 5.6, Co. Bal. (Cast and aged)	0.000440

Similar data for other values of stress and duration have been investigated and reported in the literature, on the basis of which design data have been arrived at which are helpful in deciding the suitability of an alloy for a particular application.

POSSIBILITIES IN INDIA

A large majority of the high temperature alloys are face—centred cubic at the service temperatures and the main elements present form solid solutions. The solid solutions being non-creep—resistant, alloy constituents such as carbon, molybdenum, tungsten, columbium, tantalum, titanium, nitrogen are added to strengthen the matrix by forming carbides, nitrides or intermetallic compounds. Their dispersion in the metallic matrix help in retarding creep.

A characteristic draw back of these alloys is that they lose their creep resistance rapidly above 800°C. The future largely depends upon developing alloys which will be creep resistant at higher temperatures. Among the alloys known, metals such as nickel, cobalt and iron have been, more or less, completely investigated as alloy—bases. Low melting metals such as aluminium, magnesium, silver, copper, tin and zinc are obviously unsuitable as alloy—bases for service at high temperatures, since melting points of the metals which make the alloy base is a criterion. Prohibitive cost stands in the way of metals such as platinum, rhodium, osmium, palladium etc. from being used. Therefore, comparatively only a small number of metals are primarily suited for high temperature range. As far as this country is concerned, the available metals

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Aluminum contributes to the Progress of Railways

*By *J. Balachandra*

DEVELOPMENTS in the Light Metal industry in the last fifty years have been remarkable. Aluminum has a rightful claim to be a "modern metal". Aluminum a laboratory curiosity in the latter half of the last century, now ranks second only to steel in the tonnage produced. Historically the availability of high strength alloys in large quantities is an accomplishment of the present century. Early interest in the metal has been mainly due to two important properties of the metal viz. light-weight and corrosion resistance. There has long been an awareness that the traditionally heavy rolling stock of the railways could be lightened to great advantage. However the deterrent factor has been the comparatively high cost of aluminum. It has now been realised that economic returns due to the use of aluminum are of a long term nature.

Recent developments in the aluminum industry have further focussed the attention of railways on the numerous possible uses of these alloys. Small additions of alloying elements like magnesium, Silicon, Copper and Zinc markedly alter the properties of the metal. Aluminum alloys with their low weight, good strength, resulting in high strength to weight ratio, and ductility in addition to other useful mechanical properties, suggest themselves as potential substitutes for steel in many situations. These alloys are available in all wrought shapes and as castings. They can be classified as non-heat treatable alloys and heat-treatable alloys. The non-heat treatable wrought alloys of moderate strength contain manganese or magnesium as a major alloying element. These have exceptionally good resistance to corrosion and are strengthened by cold work. Maximum strength is obtained by heat treatment of alloys containing Magnesium, Silicon, Manganese and Copper. By comparison with steel these heat treated alloys are considerably more resistant to corrosion but to a lesser extent than the non-heat treatable alloys. Casting alloys combine strength with resistance to shock. Sand, gravity, or pressure die castings can be chosen to meet the requirements of any particular application. Ease of machining and production of castings to close tolerances lower production costs. Properties of some selected alloys are given in the tables, I, II & III.

Physical properties : The important physical property is the low specific gravity which is about 1/3 that of iron and steel and less than 1/3 that of copper and its alloys

TABLE I

Minimum properties of selected Non-heat-treatable wrought alloys

Alloy B.S. 1470 (sheet)	Specific composition Major elements % Mg.	Mn.	Temper	Pr of Stress .1% (tons/in²)	Tensile strength tons/in²	elongation 2 in. %
			O	(2)	5–6.5	30
SIC	99% pure aluminum		½H	(6.5)	7–8.5	7
			H	(9)	9.0	3
			O	(3)	6–7.5	30
N3.	—	1.0–1.5	½H	(8.5)*	9–11	7
			H	(11)	11.5	3
			O	(5)	11–14	18
N4.	1.75–2.75	—	½H	12	15	5
			O	6	14	18
N5.	3.0–4.0	—	½H	11	17	8
			O	8	17	18
N6.	4.5–5.5	—	½H	14	19	8

(Continued from page 8)

are titanium, zirconium, beryllium, and hafnium. These are distributed in various parts of the country. Occurrences of cobalt and nickel are negligible. Chromium as a base has been found to be ineffective owing to the brittle nature of the alloys made and molybdenum and tungsten (which exist in the country to a minor extent) have their two fold disadvantages of high density and susceptibility to oxidation. Amongst the four metals titanium, zirconium, beryllium and hafnium beryllium because of its low melting point and hafnium because of its scarcity and high density are precluded. It is evident, therefore, that in a programme for development of high temperature alloys in this country, titanium and zirconium are bound to play a major role.

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TABLE II

Minimum properties of selected Heat-treatable wrought alloys

Alloy H10 B.S.1470 (sheet)	Specific composition Major elements % Cu.	Mg.	Si.	Mn.	Condition	Proof stress .1% (tons/in²)	Tensile strength (tons/in²)	elongation 2 in. %
H10	—	0.4 to 1.5	0.75 to 1.3	—	W	7	13	15
					WP	15	19	8
H14	3.0 to 5.0	0.5 to 1.2	0.7	0.4 to 1.2	T	14	24	15
H15	3.5 to 4.8	0.6	1.5	1.2	W	14	24	15
					WP	20	26	8

TABLE III

Minimum properties of selected casting alloys (chill cast)

Alloy B.S. 1490 (castings)	Specific composition Major elements % Cu.	Mg.	Si.	Mn.	Condition	Proof Stress .1% (tons/in²)	Tensile Strength (tons/in²)	Elongation 2 in. %
LM4	2.0 to 4.0	—	4.0 to 6.0	0.3 to 0.7	M	(4.5)	10	2
LM5	0.1	3 to 6	0.3	0.3 to 0.7	M	(4.5)	11	5
LM6	—	—	10.0 to 13.0	—	M	(4.5)	12	7
LM8	—	0.3 to 0.8	3.5 to 5.5	0.3 to 0.8	W	(7)	15	5
					WP	(13)	17	2.5
LM10	—	9.5 to 11.0	—	—	W	(11)	20	12

* Bracketed figures are typical values.

and 1/4 that of lead and silver, the density range being 162 to 180 lbs./cft for the alloys. The electrical and thermal conductivities of the pure metal rank next to copper with about 50% of its value. The natural colour and tarnish resistance are an asset.

Mechanical Properties: Apart from the wide variation in tensile strength obtainable by a suitable choice of alloy there is one important mechanical property which while apparently a disadvantage can be a practical asset. This is the modulus of elasticity. The modulus of elasticity is about 1/3 that of mild steel and indicates that for a specific stress the elastic deformation is about three times that of steel. So when stiffness is the main factor suitable change in geometric form must be made for increasing the moment of inertia of the section. On the other hand ability to withstand shock is an advantage in construction.

APPLICATION TO RAILWAYS

The earliest application of aluminum in the railways in the United Kingdom was for panelling and interior fittings of rolling stock. Even after a long and severe service the material has been found to be in good shape. Later a cast alloy LM 6 was used for connecting rods. Two of the rods supplied were found to be in excellent condition in service. Considerable advantage has been claimed for the use of light alloys in Diesel engines. In these engines there is a limitation on the weight imposed to meet axle load requirements. Aluminum is used to great advantage in panelling, superstructure and engine cooling components. Bus bars and conductors can also be of aluminum.

Within the last few years great strides have been taken in the design of light-weight trains. Use of aluminum and its alloys in the body shell and for the structural components has been extensive. The underframe and body has been of the HE 10 or HS 10 alloy. A saving of about 6½ tons as compared with steel construction has been claimed by the London Transport Executive. According to them a reduction in weight of 14% corresponds to a saving in energy of 12%. The stock of the Toronto Transit Commission has also an all body structure except for body bolsters. The main framing members are of HE 20 WP alloy. Side sheets and rivets are of N5 alloy and the floor sheets of N4—½H alloy. For carriage fittings LM5 castings and H510—Wp wrought materical have been used. A saving of 5½ tons per unit is claimed.

Interest evinced by the British Railways in aluminum and its alloys as a promising constructional material took concrete shape in the design of a light alloy electric train exhibited in 1951. The matter of saving in weight is of paramount importance on railways with high frequency of service between stations at short distances since the energy or fuel consumption is directly proportional to the weight of the rolling stock.

Again rolling stock designed for greater passenger comfort, greater speed and punctuality can be provided for fairly long journeys. If the traffic density is high, high acceleration and braking rates which are as important as speed can be attained.

In the exhibit alloy "Kynal" M 39/2 a proprietary alloy containing Manganese, magnesium and silicon, manufactured by the I. C. I. Metals div. has been mainly used for load bearing structures. There has been a saving in weight of 37% in the car body and 20% in the overall weight.

Successful competition from air and bus lines resulting in mounting deficits on passenger operations has prompted the North American Railroads to seek greater economy and efficiency of operation. During 1956 four companies designed and tested light-weight trains. The designs varied virtually from an all aluminum train to trains containing varying amounts of aluminum employed in the construction. All designs however were based on the light-weight, strength and durability of the alloys. The first of these was the Pullman Standard train 'X' a typical prototype being named the 'Xplorer'. Essentially of an all aluminum construction, the central section of the underframe was of 6061—T6 alloy, the frame of 6061—T4 alloy and the skin of 2024—T3 alloy aluminum clad. Aluminum cladding of alloy plate improves the corrosion resistance of the clad metal. The weight saving compared to a steel counterpart is claimed to be nearly one-third with about the same value of saving in cost General motors very well known as leading manufacturers of automobiles introduced the "Aerotrain," a design based on the proved performance of aluminum and its alloys in bus body design. Each train was a complete unit consisting of 10 cars and a 1200 h. p. diesel locomotive capable of speeds up to 100 m. p. h. The superstructure and the exterior have been fabricated out of aluminum alloys. The weight saving has been claimed to be 50% with a corresponding saving on maintenance and operating costs. This in fact is expected to provide a solution for low cost travel. The third design of interest is the 'Jet Rocket' by the ACF industries, basically a TalgoType design. Some new features have been introduced. It has a steel underframe with 6061—T6 aluminum alloy structural components in the superstructure and inside trim, the outer skin being of stainless steel. Apart from the light-weight resulting in 50% saving compared to a standard railway car better weight distribution, new type of suspension system and guided wheels are some of the additional features.

In our own country there is an outstanding example of the use of light-weight trains in the introduction of broad gauge multiple unit electric stock on the suburban routes of the Western and Central railways. These designs using a combination of light alloys and high tensile steel is a step in the right direction. It is a positive sign that aluminum has come to stay as one of the important structural metals in this "light alloy" age. In the stock used on these railways a saving of 26% on previous designs has been claimed.

India has vast resources of raw materials for production of aluminum and its alloys. The development of this industry is largely dependent on demands of potential consumers like the aircraft and the automobile industries and the railways. Railways can immensely benefit by the use of aluminum and its alloys in diverse applications and in turn subscribe to the rapid development of an important metallurgical industry. The appeal of the anodised and dyed aluminum in decorative finishes and inside trim will not fail to please the aesthetic sense of the travelling public. With all these developments one can cherish the fond hope that utmost in travelling comfort might be an accomplished fact in the not distant future.

PRESIDENT'S AWARD TO RAILWAY ENGINE DRIVER SAVED LIVES OF HUNDREDS OF PASSENGERS

The President has posthumously awarded the Ashoka Chakra, Class II, to the late Shri Manasser Johannes, engine driver of the South Eastern Railway. The citation accompanying the award says:

"Shri Manasser Johannes was the driver of the 315 Up Howrah-Adra-Chakradharpur passenger train approaching Khargpur from Jakpur on the night of July 26, 1956. Shortly before midnight, there was a sudden blow-back of fire from the fire box door into the cab where he was standing. Trapped in the flames, Johannes and the two firemen who were on duty with him received serious injuries. The firemen jumped out of the moving train. There were about 400 passengers in the train. Realising that a disaster must result if he too jumped out, Driver Johannes remained at his post in the flame-filled cab and though severely burnt he eventually brought the train to a stop near the outer signal of Khargpur station. He then alighted from the engine and painfully crawled back to the rear of the train to tell the Guard what had happened. Shri Johannes was rushed to a hospital but he succumbed to his injuries within a few hours of admission.

"Shri Manasser Johannes acted with great courage and heroism in order to safeguard the lives of hundreds of passengers travelling in the train in his charge. His spirit of sacrifice and devotion to duty will be a noble example to others".

The right alloy for the right job — A guide to fabrication in aluminium

*By *R. K. Chari*

"THE right material for the right job", a basic principle dating back to the beginning of scientific construction, often times is overlooked in relation to fabrication work in aluminium. This is a direct consequence of generally insufficient knowledge of the salient characteristics of aluminium and its alloys amongst our engineering circles, with their education and training basically in steel fabrication.

Aluminium with its wide range of alloys, is a versatile medium of construction suited for a variety of applications, from cigarette cases to ship superstructures. These alloys, while possessing in common light-weight and resistance to corrosion, feature a wide range of physical and mechanical properties like tensile strength, hardness etc. To derive the best advantage from fabrication in aluminium, it is essential to make the right choice from out of these alloys, having specific properties adequate to the particular application. The many alloys of aluminium commercially available in India and their salient properties are discussed below in some detail.

Aluminium sheets, now being produced in India in a number of alloys, can broadly be divided into two groups; (i) those in which the mechanical strength is achieved by cold rolling or work-hardening, and (ii) those in which the mechanical strength is developed by heat-treatment after rolling. Among others, commercially pure aluminium belongs to the former category and duralumin alloys, used in aircraft construction, fall under the latter.

* Indian Aluminium Company, Ltd., Calcutta.

The range of mechanical properties, in which sheets in varying tempers in these alloys are available, are shown below:

Alloy Specification	Type	Ultimate tensile strength (in tons/sq. in.)	.1% proof stress (in tons/sq. in.)	Brinell Hardness Number
I.S. SIC	Work-hardening	$5\frac{1}{2}$—10	2 —9	21—44
I.S. NS3	Work-hardening	7 –13	3 —11	29—55
I.S. NS4	Work-hardening	12 –$16\frac{1}{2}$	5 —$14\frac{1}{2}$	48—76
I.S. HS 20	Heat-treatable	8 –20	$3\frac{1}{2}$—17	60—90
I.S. HC 15	Heat-treatable	$12\frac{1}{2}$–31	$5\frac{1}{2}$—26	115—135

The fabricator, therefore, has a considerable range to choose from to suit the mechanical strength demanded by each application. The different tempers in each alloy make available varying degrees of workability in operations like pressing, folding etc. Some other important properties are comparative resistance to corrosion and surface finish. Pure aluminium, I. S. SIC, ranks the highest in corrosion resistance, with the other alloys, I. S. NS3, NS4, HS 20 HC 15, coming after it in order. While this is true in a general sense, the magnesium bearing alloy, I. S. NS4, is superior in resistance to corrosion by marine atmospheric conditions. Where surface finish, which is very often improved by resort to anodising, is important, alloy I. S. SIC is again the best choice. In applications like floor plates for platforms etc., calling for high wear-resistance, alloy I. S. HS 20 is an excellent choice.

Aluminium sections, like angles, channels, tubes etc. and specially designed profiles for particular uses, are being produced in India, by the extrusion process. The range of mechanical properties of these alloys, in the various tempers, are shown below:

Alloy Specification	Type	Ultimate tensile strength (in tons/sq. in.)	.1% proof stress (in tons/sq. in.)	Brinell Hardness Number
I.S. HE 9	Heat-treatable	7—16	5—12	45—75
I.S. HE 10	Heat-treatable	15—20	9—18	60—90

Here again, the different tempers enable different degrees of workability. For stressed structural applications, sections in I. S. HE10 alloy, which has high mechanical strength, are best suited. For architectural applications like windows, doors etc. and for trims and mouldings, where asthetics are of prime importance, I.S. HE 9 alloy is the ideal choice, since it combines adequate strength with fine surface characteristics suited to finishing processes like anodising, polishing etc.

Satisfactory and durable fabrication of any component demands careful consideration of a number of factors in selecting the material for construction; to mention only the more important, adequate mechanical strength, suitability for fabrication operations involved, and resistance to corrosive factors. Depending on the demands of each application, these and other pertinent factors assume importance in relative proportions. Failure to conform to the principle of "The right material for the right job" often leads to unsatisfactory, and occasionally disastrous, results. The need for choosing the right alloy and temper of aluminium for each job, in the light of its duty conditions, cannot therefore be exaggerated.

Admittedly, an article of this nature hardly permits an exhaustive discussion of the many aspects, knowledge of which enables the right choice. It is hoped, however, that the foregoing will help in achieving a widened appreciation of the variegated range of section that aluminium offers. The aluminium industry in the country also places at the service of fabricators technical advice and assistance, in order to facilitate the most adequate and advantageous utilisation of aluminium.

MYSORE IRON AND STEEL WORKS

The Mysore Iron and steel Works, Bhadravati, has completed the erection of a new cast iron spun pipe plant at a cost of Rs. 55 lakhs. The plant will be inaugurated this month by the Union Minister for Steel, Mines and Fuel, Sardar Swaran Singh. The new plant will enable the Mysore Iron and Steel Works to increase the production of iron pipes needed for water-supply schemes. The erection of the plant completes the first stage of the development of the Mysore Iron and Steel Works under the second Plan.

The Mica Mining Industry in India

By *D. B. Sahana, B.A., F.G.S.(Lond.), A.M.I.E.T.(Lond.), A.I.M.M.(Lond.), A.I.M.E.(U.S.A.), M.M.G.I., F.G.M.S., M.I.S.E.

IN the modern age of industrialisation, electricity and electrical appliances, as you all know, are of very great impertance and use. Mica is considered to be a very important material in the construction of electrical machineries of all kinds. A country with sufficient amount of mica deposits is thus considered to have unique and strategic position in the world. For your information I may tell you that India is at present supplying about 80% of the world's requirements of mica. In the present days of India's intimate connection with the U. S. A., it is found that mica is one of the principal dollar earning materials of India. The importance of mica industry is, therefore, cannot be over emphasized. So I would like to address you on the subject of Mica Mining Industry in India—its history and development.

At the outset, I would refer to you about the discovery and use of this important material in India in the past. From available source I may tell you that mica was largely employed in the ancient Hindu System of medicine. I may also inform you that though there is not any definite documentary evidence, India had trade relations with the Roman Empire in the past. The amphitheatre in Rome used to be decorated with the spreading of powdered mica, thus imparting a glistening effect. In those days, mica used to be exported to Europe under the name of 'ABHRA' which was regarded as 'Talc' in the foreign market. From the information I could gather, I may say that mica was first produced in Bihar in India and this used to pass as 'Bengal Mica' in England and other foreign markets, and had the reputation for its fine quality and its beautiful ruby colour.

Mica (Muscovite) in Bihar, occurring in the pegmatites and for its peculiar colour and lustre, could attract the notice of some of the local aborginal tribes known as the Labanas and Mahajins inhabiting the different places in the Bihar Mica Belt. These peoples started producing mica from narrow cylindrical shafts, not exceeding a depth of 30 feet on an average, in and around Kodarma. As they did not known the use of explosives, they invariably avoided to bore holes in the harder pegmatite rocks for the recovery of mica, but they had enough intelligence to attack the pegmatites by burrowing through the softer mica-schist country rock on either side of the pegmatite containing valuable books of mica, which were taken out a random. Mica thus extracted used to be placed in the market for various local uses for decorating and medicinal purposes. Those places where the aboriginals began their operations turned out afterwards to be some of the best mica mines in the locality.

After this period of the activities of Labanas and the Mahajins, there was big gap or dark period when no mica was produced due to several factors both political and economic, or foreign invasion, of which we have very little documentary evidence. But we have some amount of definite information about the beginning of systematic mica mining in the year 1880 or thereabout by some enterprising men like F. F. Chrestien, Raj Krishna Sahana, W. R. Macdonald and Manoranjan Guha Thakurta, who were pioneers in this industrial development. The old system of mining that was prevalent amongst the Labanas was not strictly followed by these industrialists, but they started an improved method of mining and as gunpowder, a mild explosive which was available at that period, was freely used, the hard pegmatite rock was directly attacked and blasted. Thus they could reach greater depths to extract mica books. The only method that was adopted for both pumping out of water and haulage, was by the employment of manual labour which was freely used. The water that accumulated in the shallow mines used to be baled out by human agency and the debris which accumulated in the mines after blasting used to be removed by labourers with the help of iron pans.

This state of mica mining continued for a good length of time until the World War 1, when steam engines, steam boilers, steam haulage engines and steam pumps and high class explosives like dynamites, gelignites etc. together with detonators were introduced. These improved devices gave an impetus to the Bihar Mica Mining and greater and greater depths could be attained without much difficulty, the depths reached varying between 100 and 200 feet.

After 1924 or 1925 pneumatic drills operated by air compressors and better facilities of haulage system had been introduced thereby increasing the efficiency in

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the matter of increased production of the mica and safety of the mines. Much greater depths could be reached by these better mining methods and 500 to 600 feet depth is quite easy under the present day mining conditions.

This state of affairs has been going on but more efficient mining and increased production will only be possible when improved mechanised mining is introduced with the application of machineries operated by electricity. With such improved types of machineries, it will be possible for us to reach even greater depths and to quicken the production of mica, so that the increased production may compensate the overhead cost of improved types of machineries. The Damodar Valley Corporation should supply electricity to the mica mines at chief rates as early as possible, so that the mica industry may take advantage of it for the sake of stepping up mica production which will ultimately lead to the welfare of the nation.

Regarding the transport in the area where mines are scattered in different inaccessible parts of the mica belt covering an area of more or less 1500 sq. miles, I may point out that the position is very unsatisfactory because there is practically no good all weather roads in this region. For want of this communication facilities between the factories and the mines, the work in the production is seriously affected. The improvement in the transport facilities should be immediately undertaken by the Government, so that the work of mica mining can be carried out smoothly.

Those who have practical experience of mica mines in Bihar will bear me out when I say that for want of good roads, we cannot take suitable machineries to the site of mines for improved production. I think the attention of the Government should be focussed to this transport problem facing the mica industry. The road cess that is being collected at the rate of —/8/— annas per maund of mica every year should be utilised for the improvement of communication in the mica mining area. If this fund appears to be rather inadequate, certain amount of money can be diverted from the labour welfare cess which is also accumulating at the rate of about ten lacs of rupees per annum.

As this transport problem is seriously standing in the way of development of the mica industry, we are really very anxious to see that immediate improvement is done in the direction. I think I am voicing the opinion of all who are vitally interested in the mica industry of Bihar.

PROCESSING OF MICA

After Mica has been produced from the mines it is transported to the factories, which are mostly located far away from the mines, where the crude mica is processed.

Regarding the different stages of processing, I may mention that crude mica books are first rifted and cut by sickles to remove the flaws in order to recover the valuable portions. This method has been going on since the inception of the mica industry in this part. The rejections of mica by this method come to about 80% of the run of mine. These rejections are put in dumps and later on tapped to recover small percentage of mica for splittings. The only deviation made from the long standing method of cutting of large size mica by sickles in Bihar is by knives. This has proved to minimise waste in production of cut mica. The mica occurs in various places in South India in pegmatites and the most important mica mining centre nowadays being concentrated in the Nellore Dt. Mica mining was started in South India from very old days. The Nellore mica belongs chiefly to green variety (muscovite) and the quality varies between clear and heavily stained and spotted. The cutting of Nellore mica is chiefly done by scissors into different sizes of round, square and rectangular shape. Recently the Bihar method of cutting by sickle has also been introduced in Nellore area. The grading however, is the same as in Bihar.

The pegmatites of Travancore contain phlogopite mica of good quality which has got special uses.

The mica miners in Rajputana follow the usual method of mining mica from the pegmatites. Rajputana mica belongs to ruby variety (muscovite), quality being mainly stained and heavily stained. They have also adopted the Bihar method of cutting and grading with great success. Moreover, sufficient amount of Rajputana mica comes to Bihar for splitting and subsequent export to foreign markets.

With the introduction of electrical appliance in the latter part of the last century use of mica gradually went up, and the importance of graded mica was realised by the manufacturers. In this way, grading of mica into different sizes came into practice in our mica industry and the same thing has been going on except minor modification from time to time e. g. introduction of sizes of Nos. $4\frac{1}{2}$ and $5\frac{1}{2}$. The Indian Standards Institution is trying to introduce standards and various specifications of finished products coming out from different industries. Regarding mica, they are suggesting metric system of measurement in the grading of mica sizes. But as far as the information goes neither the foreign buyers nor the Indian producers seem to be *in favour of such method.*

Now regarding quality, it will be said that it varies between wide limits due to the presence of impurities in the shape of various forms—both inorganic and organic. Quality is classified into clear, *SS*, *FS*, *GS*, stained, heavily stained and densely stained due to the various and varying types of impurities. Besides, there is another variety of mica which contains lot of black spots and marketed as black-spotted mica. Some researches have been carried out regarding the nature of these spots and the results have already been published. The di-electric strength which in an important property of mica with reference to electrical uses varies according to the amount and nature of the spots. Price of such mica also varies accordingly. The grading of mica into various qualities as is done in India by visual tests, can not be described as a very perfect method. Testing of mica done by electrical devices is being carried out in U. S. A. for grading into quality, and I think this method of mica testing is worth trying in India because this may prove successful in the method of proper grading of mica into different qualities for specific uses.

SPLITTINGS

Mica is split into very thin flakes right down to $\frac{1}{1000}$ of an inch. This art of splittings is carried out very efficiently by Indian labourers and India holds monopoly in this respect. In Bihar alone, about one lac of women are engaged in this splitting work and this may be looked upon as a cottage industry in some district of Bihar.

LABOUR

Regarding labour in the mica industry, the majority of the miners are more or less migratory and imported labourers but some of them have settled down in these localities and may be regarded as local. With regard to the factories the labourers are mostly local. Formerly, the labour bills accounted for about 50% of the mica

mining expenses but after the award of the Industrial Tribunal in 1948, there has been a substantial increase in labour wages which have amounted to more or less 66% of the mica mining expenses. Inspite of this increase in labour wages, efficiency of the labourers has not correspondingly improved. It has rather gone down.

A cess known as 'Labour Welfare Cess' is already being levied at the rate of 2½% on the export of mica and a large sum of money has accumulated in this fund. The economic position of this industry is such that any further increase in the cost of production without corresponding increase in the market value of the shipments will have a serious repercussions on the mica industry by losing her position in the world market. A good proportion of amount accumulated in the Labour Welfare Cess Fund should be utilised for betterment of the living condition of the labourers including housing, supplying of pure drinking water, sanitation and hygiene, medical aid, education including technical training as far as possible. As already pointed out earlier, road communications should be improved by having better roads throughout the mica belt. This is not only necessary for improving production of mica but also essential for labour welfare.

In order to do that and if necessary, certain amount of money from the Labour Welfare Fund may be diverted towards construction and improvement of roads.

MARKETING

From the beginning of the Mica Industry in India in the Eighties of the last Century, the marketing of mica has been confined to a small number of firms and individuals who unfortunately compete amongst themselves and sometimes cut down the prices of mica in an attempt to secure orders for Mica. Mica is also sent on consignment basis to the foreign countries. There is practically no consumption of mica in India. Consequently there is a "buyer's market" in mica and sometimes it is found that the prices obtained are uneconomic. During the Second World

War a buying organisation was set up known as the 'Anglo-American Joint Mica Mission'. The Mission bought everything which was produced by the Mine Owners and the factory owners and if I am not wrong, made large profits inspite of its heavy overhead charges.

State Trading of this important mineral may bring more foreign exchange. The State may offer the mica to the buyers abroad leaving a decent margin of profit. In the First Five Year Plan it was suggested to explore the possibility of setting up a Central Marketing Board for Mica which would reduce the complaints by the foreign purchasers about the quality of mica shipment but nothing appears to have been done so far.

STANDARDISATION

In order to have better results in marketing the different grades and qualities of Indian mica, it is absolutely necessary that we should have a standardised product with regard to grade and quality. Now, it is a matter of great satisfaction that the Indian Standards Institution has already taken upon itself the task of evolving some suitable standards acceptable to both the producers and the consumers. Results of such investigations, I am sure, would be of great help and use to the industry for marketing the mica in a more scientific way.

UTILISATION

It is no use repeating the various applications in different ways, but I would like to mention a few words about the waste or scrap mica which is lying in huge dumps scattered all over the mica fields. This is being exported to foreign countries giving us a very little return. But if finely ground mica can be prepared here and exported, we would certainly get very good return as very finely ground mica has got important industrial uses. I would, therefore, make a suggestion to the mica industry in this country to take up this project of making finely ground mica from the scrap and export it as ground mica. We should also like to have connection with the Government National Laboratories in order to find out suitable means of grinding of the scrap mica into fine powders. I hope the National Laboratories will take up this line of research and help us in the matter.

Another interesting line of utilisation of mica is in the preparation of micanite sheets out of mica splittings. This is an important line of development of mica industry in which India should specialise. A step in this direction would help us in exporting micanites with a better return of foreign currencies. Two Micanite Factories, one in Kodarma and the other in Bhopal, I am glad to say, are under construction.

TAXATION

The incidence of direct taxation (Income-tax) on the Mineral Industries in India, is the heaviest in the World as no depletion allowances are granted for taking out the wasting assets. Substantial allowance and reliefs in the form of depletion in Canada, U. S. A., Australia and other countries of the world are allowed. I am quoting below a resolution recently passed by the Mining and Metallurgical Society America:

> "The council holds that the continuance of a healthy and prosperous mining industry and the contributions it can and should make to the public revenue, to employment, to national security and to the general welfare, depends upon continuing production from now operating mines and the continuing discovering and development of new deposits. Essential to this is the hope for profits commensurate with the difficulties, the effort and the risks of losses involved. The inherent risks in mining cannot be avoided, and taxes should not be imposed in nature or amounts as will kill incentives for incurring these risks and will result in loss of government revenues and harm to the domestic economy."

The total value of minerals produced in India during 1956 was about Rs. 110 crores as compared with Rs. 70 crores in 1954. So there has been an increase of more than 50 percent. The mineral Industries deserves to be given further encouragement and incentives in order to produce more by giving relief from taxation so that the national wealth may be augmented for the successful implementation of the Second Five Year Plan. It will indeed be a short-sighted policy to kill the goose that lays the golden eggs by imposing such deterrant taxes as wealth tax. The Mineral Industries are already groaning under the heavy burden of taxation. The Mineral Industries play an important role in the economy of India and as such deserve to be encouraged in every possible way.

I am quoting below :

Half Yearly Comparative Statement of Indian Mica during 1955—57

	1955			1956			1957		
	Quantity		Value	Quantity		Value	Quantity		Value
	Tons.	Cwt.	Rs.	Tons.	Cwt.	Rs.	Tons.	Cwt.	Rs.
Mica Block	862	11	1,30,92,244	1053	14	1,56,90,738	990	8	1,62,65,623
Mica Splittings	4019	1	1,77,87,534	3636	13	1,73,52,425	3986	15	2,38,20,672
Mica Scrap	9298	17	66,00,887	6366	17	80,22,368	9009	17	79,52,587
Mica of Mixed Description	236	3	19,32,027	175	6	19,48,599	112	10	7,12,675

Metals in the Canadian Economy

*By *T. F. Harris*

THE Canadian economy, during the past decade and a half, has exhibited a rate of growth which is probably without parallel in the history of the world. The country's population between 1939 and 1957 has increased by nearly 50 per cent to over 16 million. During the same period per capita national income has risen from $388 or Rs. 1940 to $1340 or Rs. 6700, at the present exchange rate of approximately Rs. 5 to 1 Canadian dollar. The market value of goods and services produced by Canadian residents during 1956 (Gross National Product) reached a record of $29½ billion, or approximately Rs. 14,750 crores, an increase of some 11 per cent over 1955's Gross National Product. If moderately increasing prices are taken into account, the increase was approximately 7 per cent in physical output terms.

One of the most dynamic elements in this history of growth has been the development taking place in the metal's field—both ferrous and non-ferrous. These developments in turn have been sparked by a high and growing level of world demand for Canadian mineral products, as well as by far-reaching technological advances in the fields of mineral exploration and processing.

METAL PRODUCTION IN 1956

Metal production continued its upward trend in 1956 reaching a value of $1,134,400,000, 13 per cent above the 1955 total and constituting 55 per cent of the total value of mineral production. *Quantities and values of all metals produced in Canada in 1955 and 1956 are shown in the table at the end of this article.*

IRON ORE

Iron ore headed the list of actual production gains made. Output in 1956 rose to 22,500,000 short tons, a 38 per cent increase over 1955 and three times the output in 1954. Developments under way indicate a total iron-ore output of between 50,400,000 and 67,200,000 tons within the next decade. More than 13,440,000 tons of the 1956 output came from mines in Labrador and Quebec of the Iron Ore Company of Canada. Additional iron ore output is coming from the treatment of pyrite and pyrrhotite by Norander Mines Ltd., in two sulphur-iron plants in Ontario, and by International Nickel Company in a new $19 million ammonia-leaching plant at Copper Cliff near Sudbury, Ontario. Eventual actual production from this plant will be at the rate of one million tons of iron ore grading more than 65 per cent.

Increased attention is being paid to properties containing low-to-medium-grade iron ore which are amenable to beneficiation. One such property near Hull, Quebec is being prepared for an annual production of 600,000 tons of pellets containing 66 per cent iron The higher content furnace feed thus obtained enables industry to increase blast furnace production by as much as 20 per cent without expanding capacity.

About 90 per cent of Canada's output of iron ore is now exported. Canadian consumption has increased fivefold since 1938 and in 1956 totalled 6,720,000 tons. Despite increasing output, about 72 per cent of the consumption in 1956 was imported, mainly because of geographic factors and company affiliations.

URANIUM

Uranium has become, in the short space of three years, one of Canada's major metals, and production in 1956 was greater than in any previous year. The feature of the year, however, was not the actual production but the great preparations for additional production during the next few years. The total value of agreements for delivery of uranium upto 1963 has risen to more than $1,500,000,000 and estimates of the gross annual value of uranium production in Canada by 1959 range from $300 million to $400 million. In 1956 uranium was in 8th place among metals produced in Canada, but by 1959 it is expected to be the leading metal produced in this country, unless there is a large increase in the output of one of the other metals, such as nickel.

Canada has been one of the world's leading uranium producers since the beginning of interest in atomic energy and has maintained this position despite greatly increased production in some other countries during the last few years. The recent developments indicate that this country will soon assume a much more prominent

* Canadian Government Trade Commissioner, Bombay.

place among the world producers, and the ore in the Blind River area of Ontario is now considered to be the largest proved reserve of uranium ore in the world.

COPPER

Copper production rose to an all-time high of over 706,000,000 lbs. in 1956 and this metal led all others in value of production. The increase was largely due to the expansion in nickel-producing facilities in the Sudbury area of Ontario and of a new output from Quebec's Gaspe and Chibougamau areas. When in full production the new mine of Gaspe Copper Mines Ltd., is expected to produce 125 tons of copper anodes daily. The up-and-coming Chibougamau area, from which production started late in 1953, already has three mines in operation with a combined annual output of over 50 million lbs. of copper, and several other properties nearing production. New copper production will also come this year from properties in several other areas.

About 50 per cent of the world's consumption of copper is ultimately used by the electrical industry for conductors such as wire, cable, bus-bars, etc. Increasing quantities of copper tubing are being used for plumbing. The remainder is used in brass, bronze, cupronickel, nickel-silver, and other copper alloys and as copper salts.

NICKEL

The production in 1956 of 355,986,460 lbs. of nickel valued at $223,343,992 was the largest on record and constituted about 81 per cent of the free world output. Despite this increase in production, supply remained tight as a result of high demand in the fields where nickel is traditionally consumed, as well as a continued expansion the area of this metal's application. While the manufacture of stainless and other alloy steels, and nickel cast-iron accounts for approximately 45 per cent of the nickel used in industry, its characteristics are leading to its being alloyed with various other metals. Electroplating uses about 14 per cent. Other uses are in high-temperature and electrical resistance alloys, catalysts, ceramics and miscellaneous applications. Nimonia and Inconel alloys play an important part in the field for gas turbines and jet engines.

LEAD AND ZINC

Lead and zinc production in Canada is largely from areas in which the two metals occur jointly, often with a small percentage of copper or silver. Production of both these metals in 1956 declined. Zinc output was approximately 847.2 million lbs., 2 per cent lower than in 1955 but still high enough to maintain Canada's position as the world's second largest producer. Lead production has shown a gradual decline during the past few years because of slackening in demand in outside markets. Output in 1956 amounted to 373.3 million lbs. compared with 405.5 million lbs. in 1955. Notwithstanding the decline in production, other promising lead and zinc properties are under development.

To the traditional uses of lead—storage batteries, cable covering, petrol additives—atomic energy has brought a new and expanding use based on lead's quality as a shield against radiation.

Large quantities of zinc continue to be used in galvanising, dyecasting and brass products.

GOLD

Gold, a traditional mainstay of the Canadian mining industry, was produced to a value of $150.8 million in 1956. This was somewhat less than the $157 million worth produced in 1955 which was the highest value since the record year of 1941 and which placed Canada second amongst the world producers of this precious metal. The gold industry continues to be faced with difficult economic problems arising from a fixed price for gold and high production costs and, more recently, the high premium on the Canadian dollar.

ALUMINIUM

The non-ferrous metal smelting and refining industry, Canada's second largest, is based on mineral deposits but is also a heavy user of electric power. Because of the availability of that power, most of the non-ferrous ores mined in Canada are processed within the country and for that reason huge aluminium smelters operate in Quebec and British Columbia using imported ores and concentrates.

Each year since 1952 the Canadian aluminium industry has established a new production record. During 1955, output of The Aluminium Company of Canada Ltd., which is an associate of Indian Aluminium Company Ltd., and is at present Canada's only producer, amounted to 588,000 short tons, placing Canada second in world production. This firm's present smelting capacity is 732,000 tons in its various plants and the expansion programmes now under way or planned will raise that total to 912,000 tons by 1960. Augmenting this output will be that of the newly formed Canadian-British Aluminium Company Ltd., which has a planned output of 120,000 tons by 1960.

Aluminium is finding an expanding range of applications based on its characteristics of low density, high electrical and thermal conductivity, malleability, reflectivity and high strength. In applications where these qualities are essential or desirable it has given, and continues to give, strong competition to traditional metals and other materials.

STEEL

Canada, which ranks seventh in the world in the production of steel, has had in the period since just prior to World War II the greatest proportionate increase in steel productive capacity of any of the world's major steel producers. At January 1957, Canada's steel furnaces had a rated ingot capacity of 5,504,000 net tons per annum, an increase of 6 per cent over one year earlier and of 51.6 per cent over 5 years earlier. Prior to World War II Canada's annual production never exceeded 1,500,000 tons; 1953 production reached 4,200,000 tons. In 1954, due to decreased demand, production was 3,195,000 tons. In 1955 the mills produced 4,442,000 tons and in 1956 a record 5,200,000 tons. Some measure of the industry's future is indicated by the estimate of The Steel Company of Canada that on its Hamilton, Ontario mills alone they will have to spend up to $1 billion for expansion (not including plant maintenance) over the next 20 years.

Despite the remarkable growth of domestic production, Canada imports steel from the United States, the United Kingdom, Europe and Japan. Because of the comparatively small population of Canada, this country will continue to be an importer of certain kinds, sizes and shapes of steel.

From September 8 to October 9 this year, Canada was host to the Sixth Commonwealth Mining and Metallurgical Congress. During that time Canada's mineral industry was on display to delegates from some seventy countries, who visited almost every type of mineral operation in Canada: precious and base-metal mines, coal mines, smelters and metallurgical plants, industrial mineral operations, and petroleum, natural gas and

chemical installations as well as universities and various branches of government administration, research and scientific investigation. Tremendous changes have taken place in almost every field of mineral endeavour since 1927, the year in which the Congress was last held in Canada. This article will give the reader at least an idea of some of the developments that have taken place in the metal sector of the thriving mineral industry.

Quantities and Values of Metals Produced in Canada, 1955 and 1956

Metals		1955		1956	
		Quantity	Value	Quantity	Value
			$		$
Antimony	lb.	2,021,726	563,345	1,820,000	576,300
Bismuth	„	265,896	572,362	273,007	494,157
Cadmium	„	1,919,081	3,262,439	2,258,184	3,838,913
Cerium, rare earths	„	—	988	—	—
Cobalt	„	3,318,637	8,563,700	3,685,956	9,372,760
Columbium	„	42	1,032	—	—
Copper	„	651,987,423	239,756,455	706,585,547	291,469,615
Gold	oz.t.	4,541,962	156,788,528	4,378,862	150,808,010
Indium	„	104,774	232,598	358,000	805,500
Iron Ore	ton	16,283,177	110,435,850	22,526,311	156,327,885
Iron Ingots	„	115,955	4,831,845	157,000	6,339,000
Lead	lb.	405,525,038	58,314,500	373,349,541	57,906,514
Magnesium and Calcium		—	6,585,409	—	5,617,826
Manganese ore	ton	—	—	—	1,900
Mercury	lb.	75	250	—	—
Molybdenite	„	1,389,177	823,954	1,452,028	967,461
Nickel	„	349,856,997	215,866,007	355,986,460	223,343,992
Palladium, iridium, etc.	oz.t.	214,252	8,321,633	161,600	6,495,065
Platinum	„	170,494	14,747,732	150,000	15,585,000
Selenium	lb.	427,109	3,203,319	508,000	6,858,000
Silver	oz.t.	27,984,204	24,676,472	28,794,573	25,831,612
Tantalum	lb.	390	9,760	—	—
Tellurium	„	9,014	15,774	24,000	42,000
Thallium	„	275	378	—	—
Tin	„	492,781	408,030	611,000	521,550
Titanium ore	ton	1,464	10,634	4,443	37,100
Tungsten	lb.	1,942,770	5,508,437	2,206,662	6,060,992
Uranium		—	26,031,604	—	39,577,000
Zinc	lb.	866,714,038	118,306,466	847,239,825	125,476,218
	Total	—	1,007,839,501	—	1,134,354,370

BLOWING ONE'S OWN TRUMPET

By *Dr. T. Banerjee, D.Sc. (Dacca), F.I.C., Ph.D. (Lond.), F.R.I.C., F.I.M.

[In this review article the author has described some of the contributions of metallurgists towards the development of railways. He has also described the various researches that are now being carried out in that direction and the results, obtained so far, that can be advantageously utilised by the Railway authorities.]

ARRIVING punctually at the Tatanagar Railway Station I could anyhow enter a First Class compartment of the down Bombay Mail, with my shirt and trousers completely soiled with dust from the handle and the door. Inside also the atmosphere was not cool. Two passengers were arguing about the good and bad of blowing one's own trumpet. One of them was a Railway Officer. He was the object of attack (I do not know why) and his opponent, an educated middle-aged youngman, was in the highest pitch of his excitement and extended his attack on all Indians saying that they speak more and do less. Expecting an approval from me, he looked at me. When I said that there was no harm in blowing one's trumpet, he was taken aback and remarked 'Thou too Brutus.' Yes, conservative people do not look upon this blowing as a good act though almost all are eager for it. After all, can we not take it as a sort of social service? If a doctor praises himself (Concise Oxford Dictionary Third Edition puts 'blowing one's own trumpet' as a 'praising oneself') and does advertisement of himself, we come to know thereby about him and can take his help if and when we require the same. Who does not blow his own trumpet? Innumerable advertisements in various newspapers, journals, magazines, etc. are all but manifestation of the same act. You will say that bees will be automatically attracted by the fragrance of a flower. Spreading good smell, according to botanists, is nothing but an act of advertisement by the flower.

Next let us analyse the word 'one's'. This oneness changes with oneself, his family and so on. Extending the oneness still further, it will mean a country when the advertiser is called a patriot.

Any metallurgist or engineer who will look into the condition of my shirt and cloth, will immediately suggest the use of stainless steel for these handles when no dust can collect on them. It does not mean his advertisement. It will not mean blowing his trumpet. It is just dissipating informations. (The atmosphere has cooled down). You can ask the Railway Officer about the contribution of the metallurgists towards the development of railways.

Dr. T. Banerjee

Really one does not understand why the handle and other parts of a railway compartment are not made from stainless steel. Then those will not rust and such changes will decrease the depreciation cost in the long run and the cleaning cost immediately. And passengers' clothing will be spared! You will speak about the high cost of the imported nickel chromium stainless steel. Yes, stainless steel of 18 : 8 variety is

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costly as you are to import it by paying a high price. In 1956 alone India had to pay about 4 crores of rupees for importing about 6000 tons of stainless steel. But most probably you are not aware of that National Metallurgical Laboratory has developed various types of stainless steels which contain chromium and manganese and do not contain any nickel. As is well known, India is deficient in nickel, she having no workable nickel deposit. India has to pay at the rate of Rs. 15,000/- per ton of nickel imported.

As a result of systematic and painstaking investigations and after making numerous melts, compositions based on the use of totally indigenous alloying elements such as chromium and manganese and not containing nickel have been developed at the National Metallurgical Laboratory. These new substitute stainless steels utilise electrolytic manganese which also has been prepared at the same laboratory from extremely low grade manganese ore containing 10—15% manganese based on methods patented by them.

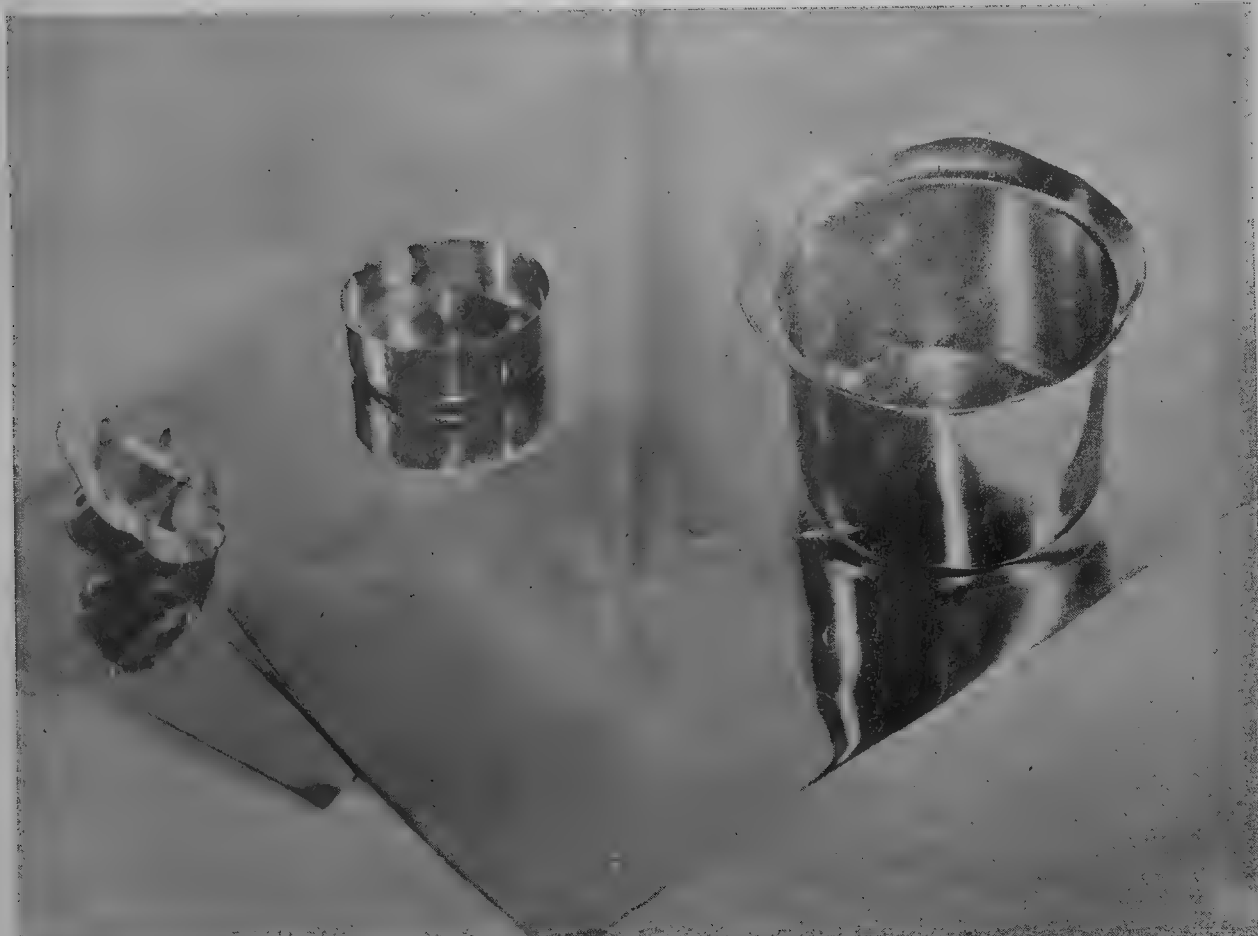
These stainless steels may be used for *automotive* wagons and liquid fertiliser tanks. They are very suitable for various railway fittings on the Indian Railway coaches and can be used for cistern and wash basin. *If you cared to look into latrines of the third* class bogies, you had certainly seen some of the lavatory pans dangerously corroded. Nowadays these are being slowly replaced by imported stainless steel pans. Corrosion of the latrine pans, made of mild steel, is very high due to the corroding action of the fæces, urine and their putrefaction products and also due to alternate wetting and drying. Cr-Mn substitute stainless steel can be profitably used for making those pans.

Let us go to the restaurant car for our breakfast. The stainless steel utensils, you use there, can be replaced by the substitute stainless steel ones. Extensive study on the corrosion resistance of this indigenous stainless steel in citric acid, tartaric acid and lime juice with or without salt have proved beyond doubt its suitability for tumblers, flatwares like thalis and katories, spoon, pots, pressure cookers and various other requirements of an Indian house or restaurant.

We shall *find during our discussion that nickel* bearing stainless steel is being used or recommended

for use in various part of the locomotive or the bogies. The Cr-Mn stainless steel can effectively replace the nickel bearing (containing about 8—10% nickel) stainless steel with considerable savings in foreign exchange. Railways are maintaining a number of hospitals involving great expenditure. Here again the substitute stainless steel can help you in saving some money, as hospital wares made out of it can resist corrosion in presence of various disinfectants, including lysol. Engineers can easily use this steel to meet their requirements about high strength structural steel. The substitute stainless steel possesses ideal resistance to industrial atmosphere and marine corrosion.

You might be thinking that we are not going ahead with the production of electrolytic manganese. We have done ample work in this direction. By working on a pilot plant scale, we have been able to collect optimum conditions for the production of electrolytic manganese from very low grade manganese ores which, at present, have no use and market and are being dumped at the mine-site. For every ton of high grade manganese ore mined either for consumption in India or for export, on the average one and a half tons of this low grade ores are dumped without any possibility of its immediate use. Total reserve of Indian manganese ores has been put at 150 million tons, of which 60 million tons are expected to be high grade, leaving 90 millions as low grade. We can very easily produce electrolytic manganese by electrolysing solution of manganese sulphate, produced from low grade ores, and ammonium sulphate. The cathode is of stainless steel and the anode is made from lead silver alloy sheet. You are enquiring about the cost of production of electrolytic manganese. I am sorry, I should have given you that figure before. If you produce 10 tons per day using ores containing 25% Mn, the cost of production of electrolytic manganese will be below Rs. 1200/- per ton. We



Substitute stainless steel sheets and utensils made out of them.

are importing the same at Rs. 3000/- per ton. It is now learnt that price has gone fabulously high.

What station is this? Kharagpur. I remember a few days before an employee of the Railways died in an accident due to some trouble in the engine. Of course I do not remember the details now. Intensive research work should be carried on the high temperature corrosion of boiler and allied problems. The informations which workers of various countries have accumulated are immense but more requires to be collected. The grate bars for firing coal is generally of cast iron which quickly deteriorate due to the combined effect of oxidation, slagging and growth. In your house you have certainly noted that grate bars of the 'chulli' corrode highly and quickly due to high temperature oxidation and attack by the alkaline ash from the coal. Use of nickel chromium cast iron of Ni-resistant type, chromium white iron or silicon iron of the 'silal' or 'Nicro-silal' type will largely increase the life of these gratings. Ni-Cr steels can also be used for fire boxes, fire doors, automatic stokers, etc.

The addition of alkali to boiler water for increasing the pH of water to 11 to 11.5 is necessary as the corrosion is then the least. Addition of sulphites, ferrous hydroxide, nitrides or any other organic reducer should be made to remove dissolved oxygen which gives rise to pitting type of attack. The alkali may induce caustic cracking of boiler which can be

Manganese Pilot Plant at the National Metallurgical Laboratory, Jamshedpur.

avoided by adding sodium nitrate with concentration maintained at about 20—30% of the sodium hydroxide alkalinity. With increasing use of higher boiler pressure it is necessary to use alloy steel for the manufacture of boilers. Use of 3.0% nickel steel, having a maximum tensile strength of 70,000 lbs. per sq. inch gives very satisfactory life. This steel also resist embrittlement much better than other steels. In America steels with carbon content of 0.1%—0.2% and about 20% nickel has been used for boiler tubes; cylinders and piston rings can also be made of nickel steel (containing 0.5—1% nickel).

Coming to railway bogies and wagons, their mild steel bodies are to be protected from corrosion. Paints should have both good corrosion resistance and mechanical properties as in addition to atmospheric attack, they are exposed to a blast of cinder, sand and stones. Specially this is more acute in desert areas. Iron oxide in ordinary linseed oil is too soft but use of tung oil, stand oil, synthetic resin etc., gives better result. Further increase in life of paint can be obtained by an additional layer of water repellent like calcium soap, aluminium soap, etc. For good adhesion of a paint the steel base or frames are given a preliminary treatment, known as phosphatising, bonderising or parkerising (these latter two being the patent names) whereby an inorganic phosphate coating is formed on the base. This coating, which is responsible for good adhesion of the paint coat, is produced by dipping the panel in a metal phosphate solution. Anybody who has gone to Perambur coach factory has seen the large phosphatising tank.

Metallising by aluminium of wagons and tanks will also increase their life. Aluminium metal is now being used, as is being done by Hindusthan Aircraft Ltd., for making passenger bogies. Stainless steel is also used for the same. Nickel steel has been used to build wagons for carrying coal because of its high strength and resistance to corrosion.

The heavy cast steel frames of locomotive wheel centres, steel cylinders, axles, crank pins, etc., when made with low nickel steel, give longer life and greater weight carrying capacity. They also possess good resistance to atmospheric corrosion. Use of substitute Cr-Mn steel deserves investigational verification. 1—2.5% Mn containing Al-Mn steel can also be used when high corrosion resistance with excellent mechanical properties is wanted.

I think you agree to the importance of using good

(Continued on page 29)

Brasses for Engineering Purposes

By *S. S. Khanna, B. Sc. (Met.)

THE word " Brass is commonly used as a general term for the whole range of copper-zinc alloys although in particular it is used for those alloys containing only 50 to 80% of copper rest being zinc. Now brasses are being used at each and every place in the Engineering side as well as domestic side. The various brasses have their own distinct extensive use due to their properties and ease with which they can be cast, extruded forged, rolled, pressed, drawn, machined or otherwise fabricated and polished. These alloys are also corrosion resistant to marine and atmospheric effects so they are extensively used for fine and minute machineries as watches, meters etc.

The different compositions and uses to which they are put to are tabulated in Table A.

The most commonly used brass in foundry is the Muntz metal or 60/40 Brass. It has got a structure of L+B brass i.e. an eutectic of L & B brass. This is the most extensively used composition in Engineering field. It is used for hot rolling of sheets plates, extruded section and castings used in machine parts. Brass articles are very common in use. They can be as small as micro screws used in watch industry to as big casting as the propeller blades of huge ships.

After hot working the properties are as follows:

Tensile strength	30 tons/sq. inch.
Elongation	40 Percent.
Youngs Modulas	14×10^6 lb./sq. inch.
Thermal Expansion	0.000020 per degree centigrade
Conductivity	29%

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wear resistant steel for the rails. Long life due to superior wearing quality and good corrosion resistance or both can be achieved by the addition of manganese, copper, nickel, chromium, etc. Of all steels, austenitic manganese type steel, with or without 3% Ni, has proved to be the best. But because of its high cost its use has been limited, as mentioned before, to locations of intense wear e. g., switches and crossings carrying very heavy traffic. These are the places responsible for miseries and woes of many families. In case of pronounced gradient 0.8% Cr. steel rails has been recommended. The presence of 0.2% to 0.4% copper in steel reduces the corrosion when the track is laid in the open in a comparatively mild atmosphere. For highly polluted atmospheres of tunnels, places near the sea-coast or factories, rails should be given sufficient protective measures with paints containing special resins or black bituminous paint or asphalt. This will reduce the tendency of the rails to pit, which gives rise to fatigue failure of rails.

At the National Metallurgical Laboratory we are always eager to be of use to industries and organisations. We have started systematic investigations on alloy steels. Some of the projects in which Railway authorities may be interested are wears of wheels and rails, production of bearing material without tin, such as tinless bronze, etc.

We are nearing Howrah. We shall have more discussion when we meet next. Your friend is a Manganese Ore Magnet! He has already become interested in our projects and wants to know more about substitute stainless steels and electrolytic manganese. If he writes to our Director, Dr. B. R. Nijhawan, we can send him the relevant reports.

So Brother, blowing one's own trumpet has worked. You want to visit our laboratory during your return journey? You are welcome and I shall be glad to take industrialists like you round on any working day. Of course, Saturday is the day when visitors in general are admitted and the staff of our Liaison & Intelligence Section take them round blowing N. M. L. trumpet, of course, in a sweet melody.

Cheerio! Good Day.

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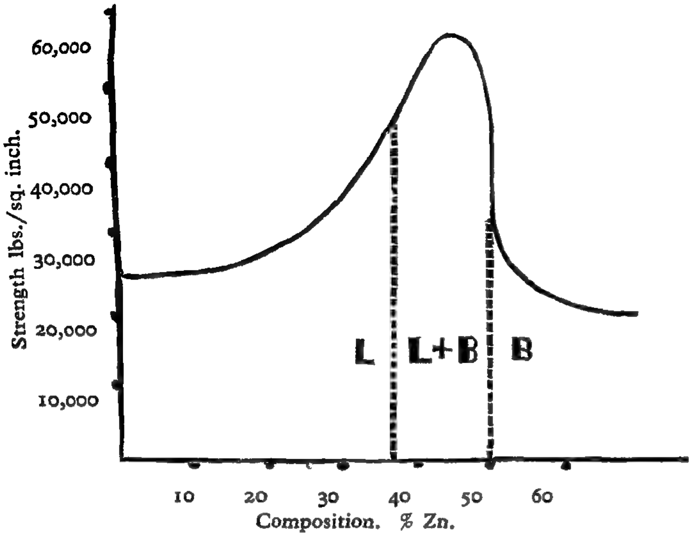

It is clear from the above diagram that the strength of cast brasses increases from about 20,000 lbs./sq. inch to more than 60,000 lbs./sq. inch with 45% Zinc, so that, by chosing the proper composition any desired strength within the limits may be obtained.

Melting Practice :— Brasses have a melting point ranging from 950 to 1100°C. Previously people were having the idea that for melting these non-ferrous metals reducing atmosphere is suitable to minimise the evaporation and oxidation losses of such metals as Zinc. But after extensive investigation now it has become a practice to use an oxidising atmosphere with a flux or reducing covering on the molten metal. The fluxes used are :—

Charcoal Powder	3%
Borax	2%
or Salt upto	5%

Borax has been found to be the best flux for brasses.

Any type of furnace Electric Induction, Oil fired or Coke fired furnace can be used.

Preparation of Alloys :—It is one of the most easiest type of alloy which can be prepared in the foundry, but on the other hand it is a difficult too. Because if the additions are not done at suitable temperature or if the

furnace atmosphere is not controlled properly then economic production of the alloy will not be possible and the whole aim of metallurgist will be gone. The standard practice can be classified as follows.

(1) The crucible is first preheated before charging the material into it. This is done so as to prevent cracking of the crucible due to the sudden change in temperature.

(2) The calculated amount of copper (pure) Electrical or scrap is charged. When this has melted down the surface is covered with charcoal and flux. This is done so to prevent oxidation and gasification.

(3) When the metal has become molten it is taken out of the furnace and Zinc and other alloying elements are added in small pieces before the casting. At the time of addition of Zinc the temperature of the bath should not be very high otherwise evaporation losses will be more.

The following precautions should be observed to reduce evaporation losses.

(1) Melting period should be short.

(2) The crucible should be full all the times and charging should be done in parts so that the cold metal over hot metal acts as a covering.

(3) Zinc is to be added in the last stage.

(4) This should be added in small pieces and should be slightly heated before charging.

(5) Zinc pieces should be pressed in the molten metal with stirring rod and they should be regularly stirred.

To increase the machinability sometimes 1 to 3% of Lead is added in the metal. This does not forms any alloy with either of the two metal but remains in suspension and increases the machinability. Inspite of all these precautions for compensating evaporation losses about 1 gm. for every 15 gms. of Zinc more should be weighed for the charge.

After the alloying elements have gone into solution the metal is poured into ingots or castings, at suitable pouring temperature to minimise the pipe formation.

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2) Non-Ferrous Foundry Practice by Laing & Rolfe.

3) Copper and Copper base alloys by Wilkins & Burnz.

BRASSES

TABLE—A

Index

A — Annealed condition.

H — Most fully work hardened condition.

Name	Composition					Typical Mechanical properties				Remarks
	% Cu	% Zn	% Pb	% Sn	% Others	Elastic Temp.	Tensile Strength Tons/Sq. In.	Elongation %	Brinell Hardness	
Cap copper	95	5	—	—	—	1(A) 12(H)	16(A) 30(H)	40(A) 4(H)	60(A) 140(H)	Caps for ammunition
Gilding Metal	90	10	—	—	—	2(A) 15(H)	18(A) 33(H)	55(A) 4(H)	60(A) 150(H)	Used for architectural metal work, imitation Jwellery.
Cartridge Brass	70	30	—	—	—	3.5(A) 18(H)	21(A) 45(H)	70(A) 5(H)	65(A) 185(H)	Deep drawing brass with maximum ductility, used for locomotive & condenser tubes and cartridge cases.
Ordinary Brass	65	35	—	—	—	4(A) 18(H)	21(A) 45(H)	65(A) 4(H)	65(A) 185(H)	A good cold working alloy, Used for utensils and general castings.
Yellow or Muntz Metal	60	40	—	—	—	4	24	40	75	Used for Hot stampings, sheets etc. Alloys hot worked only.
Leaded Brass	62.5	36	1.5	—	—	4(A) 10(H)	21(A) 35(H)	55(A) 5(H)	65(A) 150(H)	Good machinability.
Admiralty Brass	70	29	—	1	—	4(A) 15(H)	22(A) 38(H)	70(A) 10(H)	65(A) 175(H)	Resistant to corrosion by sea water. Used for tubes, plates etc.
Naval Brass	59	40	—	1	—	5 — 10	24 — 30	20 — 40	80 — 120	Fairly resistant to corrosion by sea water, Used for Marine Castings.
Manganese Bronze or High Tensile Brass	58	39	—	1.4	1% Fe .4% Al .2% Mn	8	33	25	120	Alloys combining high strength with fair corrosion resistance. only hot-worked. Used for Marine Propellers, water turbine runners, bodies of large or reciprocating pumps, autoclave valves, gear wheels etc.

WHY USE ALLOYS?

By *H. N. Sinha, B. Sc. (Met. Engg.), Banaras, M. Eng. Sc., Ph. D. (Melb.), A. I. M. (Lond.)

METALS in their pure state find a very limited application as engineering materials because they lack the required physical and mechanical properties. Recent developments in the fields of engineering and technology have placed a very heavy premium on materials and specifications which have become very rigid can no longer be met by pure metals. The properties of metals can, however, be improved by the addition of other metals and non-metals. The ever growing importance of alloys is quite evident from the amount of research which is being done in alloy technology and the number of new alloys which are constantly being developed. It is the skill of the metallurgists to develop and manipulate new alloys which is responsible for the present level of engineering and technology. Steel, which is at the root of our material civilization, furnishes a very good example of the importance of alloys as it is essentially an alloy of iron and carbon with the addition of other elements such as manganese, silicon, phosphorus, sulphur, etc., added either deliberately or otherwise.

STRUCTURE OF METALS

The crystalline nature of the metals is very well established and each crystal of a metal is built up by a symmetrical arrangement of atoms in space. The atoms are closely packed in a manner that they accommodate the forces between them. The structure repeats indefinitely in all directions and is bounded by the boundaries of the individual grains. All the grains have the same structure but different orientation in space and the grain boundary is a zone in which the atomic arrangement is not perfectly regular since it exhibits the transition state from one orientation to another.

Metals, generally, have a space lattice out of the following three common types of symmetry i. e. (a) face centred cubic (b) body-centred cubic and (c) closed-packed hexagonal structure. Most engineering materials conform to one of these three types of structure, but the actual dimensions of the unit cell are characteristic of the particular metal; though there are some minor deviations from these types also.

In the case of metallic crystals, the calculated values of the strength are far greater than those obtained in ordinary tensile tests. The discrepancy may be attributed to the fact that most metallic crystals contain either imperfections or a secondary structure of some kind which is responsible for weakness. Also, as the plastic deformation occurs by the gliding of one plane of atoms over another and the slip takes place along the planes of maximum atomic density; pure metals which usually have simple space lattice and symmetry are prove to easy deformation, thus exhibiting low mechanical properties.

MECHANISM OF ALLOY FORMATION

When a metal is added to another metal to form an alloy, in majority of the cases the alloying addition enters into a solid solution with the parent metal. If it be so, the atoms of the solute must find places for themselves within the frame work of the lattice of the solvent metal. This can be achieved in two ways:—that the atoms of the solute element should occupy lattice site of the parent metal, or that the atoms of the alloying element should occupy space in the interestices of the parent lattice. The two types of the above solutions are called, 'Substitutional' and 'Interestitial' solid solutions respectively. Substitutional type of solid solution is by far the most common; interestitial solutions are generally formed only by small atoms such as carbon, nitrogen and hydrogen, which can be easily and readily accommodated in the spaces available.

During the addition of an alloying element, a stage reaches when sufficient foreign atoms have been added and any further addition makes the solid solution unstable. At this stage a new phase appears which is of such a structure as to accommodate the interatomic forces conveniently.

The introduction of a new atom of a different size from the parent lattice causes a greater or lesser distortion in the atomic pattern and this leads to a greater resistance to deformation than does the regular atomic pattern of the pure metal. The alloy is thus harder and stronger than the parent metal.

The presence of separate phases produced by alloying

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is also quite important vis a vis to the mechanical properties of the alloy. The occurrence of the different phases in a variety of forms ranging from needle like to globular shapes and the response of the alloy to heat-treatment influences to a great extent the physical and mechanical properties of the alloy. It also provides a scope to metallurgists to vary the properties of alloys without altering their chemical composition.

MINOR ADDITIONS

Generally, by alloying it is assumed that the additions to a metal have to be made in large quantities to substantially change its structure and mechanical properties. However, the role of minor additions (elements below 1%) in affecting considerable changes in the properties of metals cannot be over emphasized when it is considered that the addition say, of half a per cent of carbon to iron results in an alloy which is enormously stronger and more versatile than the parent metal. Similarly, an increase of sulphur and phosphorus over 0.05% is harmful in steel. It is sometimes observed that the presence of a very small quantity say of the order of 0.005 per cent exerts a marked influence on the properties of a metal. The hot rolling properties of copper containing as much as 0.005 per cent bismuth are seriously impaired and as hot rolling is very often practised to make copper sheets, the presence of bismuth even in small quantities is most undesirable. Likewise, there are numerous other examples where minor additions have been used to modify the specific physical or chemical properties of metals and alloys. Some of the examples include, addition of about 0.5 per cent of titanium to stainless steel to prevent weld decay; addition of 0.75 per cent thoria to tungsten filaments to inhibit undue grain growth; presence of 0.36 per cent of lithium to eliminate the harmful effects of bismuth on copper; addition of 0.01 per cent oxygen to high conductivity copper to improve its working properties, etc.

SOME IMPORTANT ALLOYS

With the rapid developments in the technical fields especially in aviation, atomic energy etc., there has not only been a demand for newer materials but also of materials which are supposed to operate under diverse conditions. Thus, it may not be possible to find any one material which may be found satisfactory under many circumstances and the number of alloys in use in the recent years has reached a few thousand.

In view of the large number of commercial alloys which have been developed and the limited scope of this paper, it is proposed to include and discuss under various groups only a few of the important alloys. The groups have been made with respect to very similar properties and utility of the various alloys.

I. EASILY FABRICATED ALLOYS

The first category of alloys is those which are widely used in a fabricated form and are not expected to bear any appreciable load. These materials are easy to work and machine, can be deep drawn and rolled into sheets. Some of the important alloys are as follows:

Mild Steel: 0.2—0.3% C—widely used for agricultural implements, automobile accessories, building and construction hardware, electrical equipment, metal containers, wires, pressed and formed articles, galvanized sheets, etc.

Alpha Brasses: 70% Cu, 30% Zn—deep drawn structures, cartridges, condenser tubes.

Nickel Silver: 60—65% Cu, 7—30% Ni and remainder Zn—as a base for flat ware or hollow-ware, food handling equipment, marine fittings, optical & jewellery industries, spring elements in electrical relays.

Screw stock or free machining alloys: Generally steels containing 0.25% S or 0.25% Pb which make machining operations very easy.

II. HIGH STRENGTH ALLOYS

This group includes alloys which combine high strength with toughness and also corrosion resistance. They are alloys of construction and are used as wrought structural alloys. Some of them find their application for automobile parts such as shafts, connecting rod, gear, pinions and springs.

Nickel structural steels: 0.4—0.5% C and 3—4% Ni; U. T. S. 90,000—115,000 Psi.

Mild alloy structural steels: Contain 0.2—9.25% C and combination of either 3—4% Ni and 1—2% Cr or 0.75—1% Cr and 0.15—0.2% V.

High carbon, high tensile steels: 0.8—1.0% C—used for cable wires in suspension bridges etc.

Spring steels: They require a combination of strength, toughness and high yield strength. These properties are met by:

(i) Chromium—vanadium steels—0.4—0.5% C, 0.8—1.0% Cr and 0.15—02% V.

(ii) Silico-manganese steels: 1.8—2.25% Si and 0.7—1.0% Mn.

Besides the steels, light metal alloys (alloys of aluminium and magnesium) have also been extensively developed as high strength alloys. These alloys are as strong as steels when considered on the weight basis. Because of their light-weight, high strength and machinability, the alloys described below have been widely used in air-craft motors and structural parts, parts of rapidly moving machinery in the textile industry, portable equipment, etc.

Duralumin: 4% Cu, 0.5% Mn, 0.5% Mg and remainder Al., age hardening type.

Hinduminium: 1.5—3.0% Cu, 4—6% Zn, 2—4% Mn and remainder Al., besides strength these alloys are resistant to corrosion also.

Y-Alloy: 4% Cu, 1% Mg, 2% Ni and remainder Al—corrosion resistant as well.

Magnesium alloys: 2.7—3.5% Al, 0.2% Mn, 0.6—14% Zn and remainder Mg.

III. CORROSION RESISTANT MATERIALS

The third group of alloys includes materials which are resistant to water and atmospheric corrosion.

Wrought Iron: resistant to water and atmospheric corrosion used for stay bolts, hooks and chains.

Brasses:

(i) Muntz Metal: 60% Cu and 40% Zn.

(ii) Admiralty Brass: 70% Cu, 1—1.5% Sn and remainder Zn.

(iii) Naval Brass: 60% Cu, 1% Sn and remainder Zn.

Bronzes:

(i) Gun metal: 88% Cu, 10% Sn and 2% Zn.

(ii) Aluminium Bronze: 90% Cu and 10% Al.

(iii) Manganese Bronze: 61% Cu, 0.25% Mn, 0.75% Al, 0.75% Sn and remainder Zn.

Cupro-nickel: 70% Cu and 30% Ni.

The above described copper base alloys are used for making condenser tubes, valve stems, propellers, pump bodies, marine castings, etc.

IV. CHEMICAL ATTACK AND HEAT RESISTANT ALLOYS

Besides atmospheric and water corrosion, certain alloys are required to withstand the chemical attack and also retain their strength at elevated temperatures. High temperature alloys are the necessity for gas turbines, jet engines, etc. and concentrated efforts are constantly being made to develop such alloys. The alloys in this group are:

Stainless Steels:

(i) Hardenable type: 12—16% Cr.

(ii) Ferritic type: 16% Cr and above and low carbon

(iii) Austenitic type: combined Ni and Cr over 24% with not less than 7% of either; a typical composition is 18% Cr and 8% Ni.

Silchrome: 8—9% Cr, 3.5% Si and 0.4—0.45% C—exhaust value of aircraft engines.

Monel: 65—67% Ni and 30% Cu.

Inconel: 75—78% Ni, 0.2% Cu, 12.5—14% Cr and 6.5% Fe.

Nimonic alloys: Nickel base with additions of chromium, molybdenum, titanium, vanadium, etc.

Titanium base alloys: with additions of Al, Cr, etc.

Though not essentially the alloys of metals, a new and interesting field of research to develop high temperature materials has been on 'Cermets' which are ceramic base materials with the addition of metals to provide the bond and plasticity and formability. Cermets are used as turbine parts.

V. WEAR RESISTANT ALLOYS

In certain applications especially for rail roads, railway crossings, grinding balls, crusher parts, shovels, etc. alloys having wear resistant properties are required. The typical of these are:

Rail Steel: 0.6—0.8% C and 0.7—1.0% Mn.

Hadfield steel: 0.9—1% C, 10—14% Mn and 0.3—1% Si—austenitic in character and has a very good wear and abrasion resistance.

VI. TOOL MATERIALS

Tool materials are very important to ensure production and proper finishing of the engineering products. Besides hardness and strength, these alloys in many cases are expected to be non-deforming and also retain strength at elevated temperatures. Mostly alloy steels are used as tool materials and alloying elements which are generally added include chromium, vanadium, tungsten and manganese.

High speed steel: 18% W, 4% Cr and 1% V.

Silico manganese punch and chisel tool: 1.75—2.25% Si, 0.6—0.9% Mn and 0.5—0.7% C.

Die Steels:

(i) High carbon and high chromium: 12—15% Cr and 1—1.5% C

(ii) Tungsten die steels: 8—19% W, 2—4% Cr, 0.25—0.6% C and 0.3—0.6% V.

(iii) Non-deforming dies: 0.8—1.0% C, 0.2—0.4% Si, 0.1—025% V and 1.5—1.75% Mn.

Beryllium Copper: 2—2.25% Be and remainder Cu—Age hardening type used as non-sparking tools in mines etc.

Sintered carbides such as tungsten carbide with mixtures of titanium and tantalum carbides are also used as tool bits.

VII. BEARING ALLOYS

This is an interesting and 'important group of alloys and perhaps no other material is required to meet so many conditions as a bearing alloy. Hence a large number of alloys have been developed for different uses.

Tin base alloys:

(i) 80% Sn, 10% Sb and 4% Cu.

(ii) 90% Sn, 5% Sb and 5% Cu.

Lead base alloys: 82.5% Pb, 15% Sb and 1% Sn—heavy duty.

Cadmium base alloys:

(i) 98.5% Cd and 1% Ni.

(ii) 0.5—2.25% Ag. and remainder Cd.

(iii) 96—25% Cd, 3% Ag and 0.75% Cu.

Lead Bronzes: 80% Cu, 10% Sn and 10% Pb.

Alkaline earth metals bearing alloys: 96.5% Pb 0.4—0.5% Ca. and 2.5—3% Ba.

VIII. ALLOYS WITH ELECTRICAL AND MAGNETIC PROPERTIES

Finally the alloys which are used for properties such as electrical resistance, magnetic permeability and hysteresis losses, retention of magnetic properties etc. have been described below.

Electrical resistors:

(i) Nichrome: 80% Ni and 20% Cr.

(ii) Manganin: 4% Ni, 12% Mn and 84% Cr.

Transformer Sheets: 4% Si and—0.1% C.

Permanent Magnets: 10% Al, 16% Ni, 12% Co, 6% Cu, 0.7% Ti

(i) Alnico

(ii) Tungsten alloy steels: 0.7% C, 0.20% Cr, 5.5% W.

The description of various alloys given above is by no means exhaustive. New advances and developments are constantly being made in alloy technology and thus new alloys are developed every now and then. However, this paper has included some of the important alloys used in industry and elsewhere and has perhaps provided an answer to the question which was posed at the outset.

Possibility of Ferro-Manganese Manufacture in India by the Blast Furnace Technique

*By *A. K. Moitra*

INDIA, barring Russia, is the world's biggest supplier of high grade manganese ore which is largely used for the manufacture of ferro-manganese required in the making of steel. The outside demand for manganese ore is generally met by raw, unprocessed, high grade ore obtained by picking from blasted ore burden at the quarries. The reserves of high grade manganese ore are assessed at half the total Indian reserves of 120 million tons. In fact the position of the actual reserves may considerably improve on further exploration. Our high grade ores have been substantially depleted over the past decades by export to world markets for the urgent and irreplaceable use of ferro-manganese in the steel industry. The sale of high quality manganese ore has, no doubt, helped us greatly in earning foreign exchange but not to the extent it could do if the raw ores were processed within the country and sold as ferro-manganese.

Indigenous manufacture of high grade ferro-manganese is also needed to meet the home requirements consequent on the installation of new steel plants. Any surplus may be exported to earn foreign exchange, which will be more than twice our earnings by export of raw manganese ore. The foreign exchange earned by export of nearly a million tons of manganese ore amounts to about Rs. 15 crores a year, but the conversion of these high grade ores should yield about 350,000 tons of exportable grade ferro-manganese a year (containing phosphorus less than 0.3 per cent), which will fetch at least Rs. 30 crores a year, if not more. The economic benefits accruing are evident.

During the Second Plan period, licences have been granted for the production of approximately 160,000 tons of ferro-manganese, mostly by the electro-thermal process. However, it is known that the blast furnace technique of ferro-manganese manufacture is considerably cheaper than the electro-thermal process. It is estimated that the cost of manufacture of standard ferro-manganese by the blast furnace technique will be about Rs. 550—600/- per ton as against Rs. 750/800 by the electro-thermal process.

The electro-thermal process will also require low phosphorus and low ash coke (not manufactured in the country at present), although the requirements of such cokes per ton of ferro-manganese manufactured is only about 0.5—0.7 ton/ton of ferro-manganese as against 2.0—2.5 ton/ton of ferro-manganese by the blast furnace technique. The blast furnace method for the manufacture of high grade ferro-manganese has not been adopted so far because of lack of coke of suitable quality. *In view of the experiments carried out at the Central Fuel Research Institute on blending of coals for production of metallurgical coke, it now appears feasible to produce high grade exportable ferro-manganese by the blast furnace technique from indigenous coals by careful selection of blends. In fact, coke of this quality will be produced at the Durgapur Coke Oven Plant whose capacity can be increased for the production of coke required for ferro-manganese manufacture.*

SPECIFICATIONS OF FERRO-MANGANESE

Some typical analyses of the ferro-alloys used in the steel industry based on Indian high grade manganese ore are given below:

		Mn%	Fe%	C%	Si%	P%	S%
Standard ferro-manganese		78–82	12–16	6–8	1–0 (max.)	.30–.35 max.	.05 max.
Low carbon ferro-manganese	1	90	—	.07 max.	1.0 max.	.06 max.	.05 max.
	2	80–85	—	.10 max.	,,	.2 max.	,,
	3	80–85	—	.20 max.	,,	,,	,,
	4	,,	—	.30 max.	1.0 max.	.2 max.	
	5	,,	—	.50 max.	,,	,,	
	6	,,	—	.75 max.	7.0 max.	.25 max.	

* Central Fuel Research Institute.

	Mn%	Fe%	C%	Si%	P%	S%
Medium carbon Ferro-manganese.	80–85	—	1.50 max.	1.50 max.		
Spiegeleisen 1 or	16–19	—	6.5 max.	3.0 max.		
Spiegeleisen 2 alloy of iron and manganese 3	19–21	—	„	„		
	26–28	—	„	1.0 max.		
Electrolytic manganese	99–98	.001 max.	.004	nil		
Manganese metal Thermit	95–98	2–2.5	.06–.20	1–1.5		

It will be interesting to compare the composition of high carbon ferro-manganese made in India by the blast furnace technique and the quality used in America.

	Indian Fe-Mn per cent	'Standard' Grade Fe-Mn per cent.
Manganese	70/75	78/82
Carbon	6/8	7/5 max.
Phosphorus	.5/.6	.35 max.
Sulphur	.027	.05 max.
Silicon	.55	1.24 max.

The high phosphorus in our home product is mainly due to high phosphorus from the ash in our coke. The table below shows the difference in the quality of coke used in India and America in the blast furnace method of producing ferro-manganese.

COKE ANALYSIS

	India	America
Phosphorus	.18/.25%	.01/.012 %
Iron	1.25/2.3%	.75/.85 %

The average Indian ore "(oriental mixture)" has the following approximate composition :.

Mn.	Fe	SiO_2	Phosphorus
48/52%	6/8%	8%	0.10%

The manganese-iron ratio is about 7 : 1 against the Caucasian ore ratio of 60 : 1, Gold Coast 10 : 1 and Brazil 12 : 1.

The quality of manganese ore together with the Indian coke used does not give a blast furnace smelted ferro-manganese of desired quality for the export market. By careful selection of ore resources, it is possible to get manganese ore of lower phosphorus content i. e. having a maximum of about 0.09 phosphorus from Madhya Pradesh. The more serious drawback however, is the quality of Indian coke, which has an average phosphorus content of 0.2% and an iron content of 1 to 2.5%. Since 2—2.5 tons of coke are required to produce a ton of ferro-manganese in an iron blast-furnace, the phosphorus introduced into the ferro-alloy by the coke alone would be about 0.4%. The iron content of the Indian coke, and the low manganese iron ratio in the Indian manganese ores dilute the ferro-manganese, lowering the final manganese content in the ferro-alloy. Approximately 0.4% (66%) out of the 0.5—0.6% phosphorus in the Indian ferro-alloy is derived from the coke. *The crux of the problem is, therefore, to find a metallurgical coke with a much lower phosphorus content* for blast furnace production of ferro-manganese. Although, India does not have coals with very low ash, the most suitable grade available are the Giridih and Laikdih coals which have a phosphorus content of about 0.01%—.05% and could be utilized for making the right type of metallurgical coke for blast furnace ferro-alloy manufacture.

Briefly, the factors governing the making of standard grades of ferro-manganese acceptable for export are :—

(a) *Manganese-ore :*

1. The manganese/iron ratio should be as high as possible.
2. The phosphorus content should not exceed 0.1% to 0.13%.
3. The silica and alumina contents should not exceed 8 and 10% respectively.

(b) *Coke :*

1. The fixed carbon content should be 77% minimum.
2. The iron and silica contents should be 1% and 10% maximum respectively.
3. The phosphorus content should be 0.065 % maximum.

There are several ways in which the problem of making a ferro-manganese of the 'standard' grade could be tackled in India.

1. The quality of the coal could be improved by washing and/or by blending with other low phosphorus coals.

2. The use of selected Indian coals which contain low phosphorus.

INDIAN COKE SUITABLE FOR FERRO-MANGANESE MANUFACTURE

Thus it is seen that with the type of coke normally used for the production of pig iron, it is not possible to manufacture high grade ferro-manganese by the blast furnace technique. For this, coke not only of desired physical properties but with above 75% fixed carbon, 1% Fe_2O_3 / 10% silica and low phosphorus (less than 0.065%) is required. Judicious choice of coking coals low in phosphorus and other impurities, such as those from lower Karharbaree seam (Giridih), Laikdih seam (Raniganj) and possibly XI seam (Jharia) will produce coke of the quality necessary for the manufacture of ferro-manganese by the blast furnace technique.

The Central Fuel Research Institute has for the past few years, carried out extensive investigations on the blending of coals for the manufacture of metallurgical coke. As a result of these investigations it has been shown that metallurgical coke, high in fixed carbon, and comparatively low in phosphorus, ferric oxide, and silica can be manufactured from suitable blends of coals from the seams of Laikdih, Karharbaree, Dishergarh and Jharia in admixture with or without coke dust.

Typical analyses of the coals used for this investigation are given in Table I.

The physical properties of the coke from some of the typical blends amongst many studied are given in Table II.

The tests were carried out not only on the laboratory and pilot plant scales but in some cases, were confirmed by large scale tests in commercial ovens.

The test results indicate that a coke from a blend containing 50 per cent Laikdih Coal 25 per cent Giridih Coal, 20 per cent Dishergarh Coal, and 5 per cent high temperature coke dust will produce metallurgical coke which can be considered suitable for use in the blast furnace for ferro-manganese manufacture.

In fact the coke ovens of the Durgapur Project (West Bengal Government) have selected a similar blend of coals for the production of metallurgical coke for foundries. The present target of production of a little over 0.3 million tons of coke per annum will largely cater for foundries for which there is a great shortage of good quality coke. But with the expansion of the batteries, the Durgapur Project could produce coke of a quality suitable for the manufacture of high grade ferro-manganese by the blast furnace method. Besides using coke of requisite quality for high grade ferro-manganese manufacture, steps could be taken to obtain manganese ores from mines like Ukwa and Bhawali of Madhya Pradesh, which contain low phosphorus and are of a high grade. This will ensure a better quality of the ferro-manganese with the quality of coke that will be available.

During the Second Plan period the target of steel production has been set at 6 million tons. The requirements of ferro-manganese for the above quantity of steel will be roughly 100,000 tons excluding demands from

TABLE—I

Analyses of Coals used in blend for coke manufacture

	Seams				
	Laikdih (Raniganj)	Dishergarh (Raniganj)	Lower Karharbaree (Giridih)	Jharia XI	H. T. C. Coke breeze.
Analyses on Air dried bases					
1. *Proximate analysis.*					
Moisture %	0.8	3.0	1.0	0.9	—
Ash %	14.2	14.7	12.8	21.5	25.5
V.M. %	29.2	35.7	25.2	19.3	2.7
F. C. %	55.8	46.6	60.0	58.3	71.8
2. Sulphur % (Total)	0.60	0.35	0.40	0.65	—
3. Phosphorus %	0.035	0.107	0.006	0.036	—
4. Caking Index B.S.	22	17	19	15	—
5. SiO_2 in Coal	6.6	8.1	8.9	12.3	—
6. Fe_2O_3 in Coal	0.90	1.10	0.72	2.6	—

TABLE—II

Results of tests on coke from different blends

Sl. No.	Coals or blends %				Properties of coke								Analysis of Coke (dry basis)	
					Screen Analysis		Shatter Index		Micum Index		Haven Stability factor on 1"	Porosity		
					On 4"	On 1½"	On 1½"	On ½"	On 40mm	Thr-10mm.			Ash %	P %
	Laikdih	*Giridih*	*Dishergarh*	*Coke dust*										
1.	70	10	15	5	44.1	93.8	94.0	98.0	81.7	10.7	56.8	49	17.2	.045
2.	50	25	20	5	44.8	91.9	94.3	98.3	80.3	10.5	56.4	53.7	16.9	.045
3.	40	30	25	5	48.5	92.1	94.5	98.5	81.3	10.6	58.3	53.7	17.0	.052
4.	60	10	30	0	24.3	91.3	88.9	97.3	71.3	12.4	55.8	51.8	16.7	.054
5.	50	20	30	0	55.6	94.7	92.5	98.8	78.8	10.0	53.3	—	18.5	.057
	(Tested in pilot ovens)													
6.	50	20	30	5	75.6	94.7	93.0	96.4	78.2	11.0	50.1	—	18.6	.062
		95												
7.		do	do	do	74.1	93.6	94.3	97.7	79.7	9.1	49.4	—	18.9	.065
	(Tested in commercial ovens)													
8.	I. S. I. Specification for metallurgical coke (IS : 439—1953).				—	—	85.0	97.0	75.0	10.12	40.0	—	—	—
	Laikdih	*Jharia XI seam*												
9.	60	40			—	—	91.2	97.4	77.4	10.5	55.5	—	22.3	.058
10.	50	50			66.2	95.7	92.2	98.2	78.5	10.1	56.5	—	22.8	.047

other sources. Even if the prospective licensees for electrothermal ferro-manganese manufacture achieve the target of production, only a small amount of it will be available for export. It is, therefore, necessary that the manufacture of ferro-manganese should be stepped upto at least 200,000 tons to 300,000 tons a year, so that this can not only meet the internal demands for production of 15 million tons of steel visualised during the Third Five Year Plan, but also leave a surplus for export to earn foreign exchange.

COST ESTIMATES FOR THE MANUFACTURE OF FERRO-MANGANESE

The cost estimates is based on the production of about 400 tons a day (or 146,000 tons a year) of ferro-manganese (grade 80–82 manganese). The raw materials required (for a ton of ferro-manganese of 80–82 Mn. content) are Manganese Ore (40%—46% Mn.):— 2.7 to 3 tons, coke of requisite quality: 2.0 tons, Limestone: 0.6 tons, total: 5.6 tons.

It has been mentioned earlier that for ferro-manganese manufacture, the raw materials should have a minimum of phosphorus. The phosphorus percentage in the manganese ore should be within 0.09% to 0.13% as is usual in the high quality Madhya Pradesh ores. For the manufacture of 400 tons of ferro-manganese a day, it will be necessary to install two blast furnaces of 200–250 tons/day capacity. The ferro-alloy produced from the furnace will be poured on sand beds in pouring bays near the furnaces and will be loaded from there to wagons. The slag will be carried in laddle cars to a dump. Thus it will be necessary for the two blast furnaces to have equipments for binhandling, preparations of burden, charging, hot blast supply, blast furnace gas cleaning with the preliminary and flue cleaning and gas holder. Provision has also to be made in the estimates for distribution of water, cooling towers, a high level tank, compressed air, oxygen supply, slag laddle cars, buildings, foundations, track system and erection. For these, the investment cost will approximately be Rs. 5 crores excluding the provision for coke ovens. It is presumed that the project for the manufacture of ferro-manganese will be integrated with a coke oven plant. The surplus blast furnace gas (having a calorific value of about 115 B. t. u./cu. ft.) can be utilized then partly for heating the ovens and partly for steam raising in the existing power plant.

For the production of 400 tons of ferro-manganese per day, the raw materials that will be needed are as follows :—

	Per ton (of Fe-Mn)	*Per day*	*Per year*
Manganese ore	3.0 tons	1200 tons	438,000 tons
Coke	2.0 tons	800 ,,	292,000 ,,
Limestone	0.6 tons	240 ,,	87,600 ,,
Electricity	140 kwh	56,000 kwh	—
Blast	7200 Nm^3	3×10^6 Nm^3	
Water (circulating, cooling, gas cooling etc.)	—	9.02 mil. gals.	—
Water (makeup)	—	0.439 ,,	—

Production:-

Ferro-manganese (80–82% Mn.)		400 tons	146,000 tons
Slag	1 ton	400 tons	146,000 ,,
Blast furnace gas (total)	8600 Nm^3	3.5×10^6 Nm^3	1277×10^6 Nm^3
Surplus Blast furnace gas	4300 Nm^3	1.7×10^6 Nm^3	635×10^6 Nm^3

PRODUCTION COST

The calculation is based on the following assumed values — of the raw materials delivered at plant viz. manganese ore Rs 150/- per ton, Coke Rs. 56/- per ton, Limestone Rs. 18/- per ton, Blast furnace gas at Rs. 6/- per 1000 Nm^3, Electric power at 3.5 n. p. per kwh. The total personnel required will be of the order of 350–400 men for three shift operations and their wages will be similar to that in the steel plants.

(i)	Cost of ore @ Rs. 150/- per ton	Rs. 6,57,00,000
(ii)	Cost of coke @ Rs. 46/-	Rs. 1,34,32,000
(iii)	Cost of Limestone @ Rs. 18/-	Rs. 15,76,800
		Rs. 8,07,08,800
(iv)	Running expenses including 4% interest on capital, depreciation, maintenance, services, water & power etc.	Rs. 1,00,00,000
		Rs. 9,07,08,800

	B/F.	Rs. 9,07,08,800
Credit for surplus blast furnace gas for other utilities		Rs. 38,10,000
		Rs. 8,68,98,800
	Say	Rs. 8,68,98,000

Since the annual production of ferromanganese will be 146,000 tons, the cost of production of ferro-manganese will be Rs 590/- per ton or say Rs. 600/-. Since the selling price of 80/82 grade ferro-manganese is approximately Rs. 1000/- per ton, the net profit will be considerably more than that of ferro-manganese produced by the electric smelting process, where the cost of production varies from Rs. 750–800 per ton depending on the cost of electricity.

Ferro-manganese is one of the basic materials required for the iron & steel industry all over the world. The demand for this ferro alloy is to be increased with the increase in steel production both at home and abroad. The production of good quality ferro-manganese apart from earning increased foreign exchange, has to be developed in the larger interest of the country.

THIN-SKINNED WIRE

Westinghouse Electric Corporation engineers in the United States are reported to have developed a "thin-skinned" copper wire which will increase the efficiency of electrical equipment. Using a new metallurgical technique, company scientists have succeeded in coating copper wire with a thin, protective aluminium "skin" that is only one-fortieth as thick as the average skin on the human body. The coating is said to make it possible for the wire to operate over long periods of time at higher temperatures.

(Continued from page 4)

The first public train was five cars long and, needless to say, jammed to capacity. The cost of the ride was five cents, as compared to eight cents via the old route across the river.

President Theodore Roosevelt started service from his desk in Washington when he pressed a button to set the signals for the train. Within 24 hours nearly 100,000 curiosity-seekers had experienced the sensation of riding beneath the river.

The fanfare surrounding the opening of the first tunnel by no means dampened the spirit of the crowd for the second inaugural at 3 p. m. on July 19, 1909.

In all 30,000 to 40,000 people took part in the festivities. Two miles of streets were lit up with decorations.

There was a parade from the tunnel station to New York's City hall, speeches by gathered notables. Two thousand waited in line for the first trip. President William H. Taft sent a congratulatory telegram.

At 3 p. m. promptly, McAdoo's daughter, Harriet, pressed a gold button that turned on the electric current for the railroad cars. Immediately, the four trains waiting to make the first dash across the second under-river tunnel sounded their whistles. Every craft in the river and New York Bay joined in the chorus of whistles, horns, and shouts. Forty bombs were tossed into the air by celebrants in New Jersey. Bunting was displayed on all public buildings and those who didn't press forward to get a ride on the first trains stormed New York's City Hall, where the mayor threw a party that boasted "enough punch and lemonade to flood one of the new tubes......lunch and cigars."

The melee continued for 18 hours.

Today, all is gleaming and bright in New York, the city of the fast pace. People rush to and from their jobs without an outward thought.

They say, though, that if you listen very closely as you ride through the Hudson and Manhattan tunnels, you can still hear faint cheering, a distant horn being blown, a vague shout that accompanied the opening of "one of the greatest engineering feats ever accomplished; greater even than perhaps the Panama Canal."—Globe Press Service.

METRIC SYSTEM IN IRON & STEEL INDUSTRY

The adoption of metric system in the iron and steel industry in India is reported to have been discussed at a meeting of the representatives of steel interests at Calcutta recently. The meeting recommended that from April 1, 1958, the metric system should be adopted by the industry in the purchase of the main raw materials and fuels like iron ore, coal and lime stone and in the sale of their products. The quantities and prices are likely to be expressed in metric units from that date. The meeting urged that metric system for steel should be finalised and the relevant standards should be published by the Indian Standards Institution and approved by the Government by December 1957.

* * *

PROGRESS AT BHILAI STEEL PROJECT

According to a statement of the General Manager of the Bhilai steel project, timely supply of machinery from the Soviet Union has helped the authorities in India in maintaining the progress of work according to schedule. The statement added that Bhilai is being linked with the iron ore mining areas by constructing a fifty-six mile long railway line which is expected to be completed by the end of December next. The ores reportedly have been found to be of very good quality. Besides, good quality of lime stone to be used in the blast furnace of the steel project has been found in Nandini mines which is also being linked by rail and road with Bhilai.

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ELEVENTH ANNUAL TECHNICAL MEETING OF THE INDIAN INSTITUTE OF METALS AND SYMPOSIUM ON RARE METALS

(1st thru 5th December 1957)

A Symposium on RARE METALS organised by the Atomic Energy Establishment, Government of India, The United Nations Educational Scientific and Cultural Organisation and The Indian Institute of Metals will be held along with the 11th Annual Technical Meeting of the Indian Institute of Metals from Sunday, 1st December to Thursday, 5th December 1957, at the Walchand Hirachand Hall of the Indian Merchant's Chamber, 76 Veer Nariman Road, Churchgate, Bombay 1. About 25 technical papers dealing with the extraction metallurgy of Uranium & Thorium, treatment of irradiated fuel elements and breeder blankets, present status of zirconium and beryllium metallurgy and resources of rare earths etcetra will be presented and discussed by experts from foreign countries viz. U. K., U. S. A., France, Australia, Brazil etcetra and eminent Indian experts. Among others, the following foreign experts will attend the Symposium.

Professor Felix Trombe
Directeur du Laboratorire des Terres Rares
C. N. R. S., Bellevue, France.

Mr. L. M. Wyatt
Head of the Metallurgy Section
Research & Development Branch
U. K. Atomic Energy Authority.

Dr. T. R. Scott
Division of Industrial Chemistry
Commonwealth Scientific and Industrial
Research Organisation
Australia.

Prominent Indian Scientists including Dr. K. S. Krishnan, F. R. S., Director of National Physical Laboratory and President of The Indian Institute of Metals, Dr. H. J. Bhabha, F. R. S., Chairman of Atomic Energy Commission, Dr. D. N. Wadia, F. R. S. Geological Adviser to the Department of Atomic Energy, Govt. of India, Dr. B. R. Nijhawan, Director, National Metallurgical Laboratory, Dr. Brahm Prakash and Dr. J. Shankar of Atomic Energy Establishment, Bombay, Dr. D. P. Antia, Honorary Secretary of The Indian Institute of Metals are expected to take part in the Symposium and the Annual Meeting.

Titles of papers to be presented at the Symposium are attached.

Besides the above, 28 research papers will be presented and discussed in the Eleventh Annual Technical Meeting of The Indian Institute of Metals. Titles of these papers are also attached.

The five day programme will be inaugurated by Dr. H. J. Bhabha, F. R. S., Chairman of The Atomic Energy Commission at 10—30 a. m. on 1st December 1957. The annual Pandya Memorial Lecture will also be delivered on the morning of the 1st December.

The 4th Educational Lecture Series on 'Phase Transformations in Steel' and the 4th Metallographic Contest and Exhibition will also be inaugurated on the same day.

The Annual Dinner of the Institute will take place at Taj Mahal Hotel in the evening of 2nd December 1957.

Visits have been arranged to the Swimming Pool Type Atomic Reactor 'APSARA', the new Canadian Reactor under construction and to Premier Automobile Works.

Papers to be presented at the Eleventh Annual Technical Meeting of I. I. M.

TITLE OF PAPERS	NAME OF AUTHORS
1. Simultaneous determination of copper, aluminium and Magnesium in Zinc Alloys for die-casting by the porous cup-spark technique.	Dr. B. C. Kar, Mr. M. K. Gupta & Mr. V. Muthukrishnan of National Metallurgical Laboratory, Jamshedpur.
2. Hydrogen in Steel-melting processes.	Mr. V. Yavoisky & Mr. S. Roy of Indian Inst. of Technology, Kharagpur.

3. Continuous casting of steel.	Mr. V. Yavoisky & Mr. P. K. Sen of Indian Inst. of Technology, Kharagpur.
4. Martensitic transformations in Steels.	Dr. Rajendra Kumar, Indian Inst. of Technology, Kharagpur.
5. Principles of Heat Transfer in the Fuel efficiency of Blast Furnaces.	Mr. B. I. Kitayev, Dr. Rajendra Kumar & Mr. S. G. Mukherjee of Indian Institue of Technology, Kharagpur.
6. Aluminising of steel by the Aquous Flux Process.	Mr. S. M. Arora, Mr. P. K. Gupte & Dr. B. R. Nijhawan of National Met. Lab., Jamshedpur.
7. A study of early stages of tempering in a 0.2% C, 9% Cr. & 0.38% V Stee.	Dr. A. K. Seal of Bengal Engineering College, Shibpore, Howrah.
8. Deformation texture in Cold-drawn Nickel rods.	Dr. K. Tangri of Atomic Energy Establishment, Bombay.
9. Some observations in Recrystallization and grain growth in Aluminium.	Mr. A. L. Malhotra & Dr. P. Dayal of College of Min. & Met., Hindu University.
10. Fibre texture of recrystallized aluminium wire.	Dr. P. Dayal & Mr. S. Dey of College of Min. & Met., Hindu University, Banaras.
11. Plating on Aluminium using an Iron inter-layer Part I. Application of an iron inter-layer with subsequent flash-plating of copper or brass.	Mr. D. S. Tandon & Dr. T. Banerjee of National Met. Lab., Jamshedpur.
12. Plating of Aluminium using an iron inter-layer Part II. Application of an iron inter-layer without subsequent flash-plating of copper or brass	Mr. D. S. Tandon & Dr. T. Banerjee of National Met. Lab , Jamshedpur.
13. Plating on Aluminium using an iron inter-layer Part III. Use of iron inter-layer, deposited from ferric chloride solution at temp. lower than 95°C and without flash-plating of copper or brass.	Mr. D. S. Tandon & Dr. T. Banerjee of National Met. Lab., Jamshedpur.
14 Preparation of Titanium alloys by Alumino-thermic reduction, Part II. By use of Energisers.	Mr. R. A. Sharma, Mr. A. N. Kapoor & Dr. A.B. Chatterjea of National Met. Lab. Jamshedpur.
15. Hot Cathode technique for preparing Titanium.	Dr. H. N. Sinha of College of Min. & Met. Hindu University, Banaras.
16. A note on the design of Regenerators.	Prof P. R. Dhar, Prof. B. I. Kitayev & Mr. S. G. Mukherjee of Indian Inst. of Technology, Kharagpur.
17. Role of carbide in Heat-Treatment of Steel.	Dr. Ing. G. Mukherji of Bhillai Steel Project, Durg.
18. The Heat Capacity of solid solutions of Cadmium in Silver.	Prof. Ralph Hultgren & Mr. K. N. Rao.

19.	Friction & Frictional Wear.	Mr. B. N. Das & Mr. R. Chowbey of National Met. Lab. Jamshedpur.
20.	Determination of Equicohesive temperature.	Mr. R. Tambankar of R. &. C. Lab., TISCO., Jamshedpur.
21.	Some observations on the Portevin-Le Chatelier Phenomenon.	Mr. R. Tamhankar of R. & C. Lab., TISCO., Jamshedpur.
22.	Studies on Silico-manganese Steels, Part I. Influence of Carbon Content on Hardenability.	Mr. S.N. Asthana, Mr. D.K. Sood & Mr. T. V. Cherian of R. & C. Lab., TISCO., Jamshedpur.
23	Studies on Silico-Manganese spring steels, Part II. Influence of Quenching temperature on Hardenability.	Mr. D.K. Sood & Mr. T. V. Cherian of R. & C. Lab., TISCO., Jamshedpur.
24.	Studies on Silico-manganese spring steels, Part III. Influence of alloy additions - Chromium and Silicon - on Hardenability.	Mr. D. K. Sood & Mr. T. V. Cherian of R. & C. Lab., TISCO., Jamshedpur.
25.	Studies on Silico-manganese spring steels, Part IV. Effect of Carbon Content on Flexure Properties.	Mr. S. Jayram, Mr. H.R.S. Rao, Dr. V. G. Paranjpe & Mr. S. Visvanathan of R. & C. Lab., Jamshedpur.
26.	Studies on Silico-manganese spring steel, Part V. Temperability.	Mr. S. Jayram, Mr. H. R. S. Rao & Dr. V. G. Paranjpe of R. C. Lab., Jamshedpur.
27.	A new approach to the Synthesis of metallic Hydrides.	Dr. S. Ramamurthy of *Indian Inst. of Science*, Bangalore.
28.	Production of some less common metals by Fused Salt Electrolysis.	Mr. R. K. Mangal & Dr. H. N. Sinha of College of Min. & Met., Banaras.

Papers for presentation at the Symposium on RARE METALS

1.	Indian Resources of Rare Metals	Dr. D. N. Wadia, F. R. S. Geological Adviser, Dept. of Atomic Energy.
2.	Review of Beneficiation techniques pertaining to Uranium bearing ores.	Mr. P.I.A. Narayanan, Asst. Director, National Metallurgical Laboratory, Jamshedpur.
3.	Beneficiation of Indian uraniferous ores and beach sands.	Dr. R. Krishnaswamy, *Atomic Energy* Establishment, Bombay.
4.	The extraction & recovery of uranium ores from Australian ores.	Dr. T. R. Scott, Division of Industrial Chemistry, Commonwealth Scientific & Industrial Organisation, Australia.
5.	Problems in the leacbing and extraction of Indian low grade uraniferous ores.	Dr. J. Shankar & Mr. B. H. Krishna, Atomic Energy Establishment, Bombay.
6.	Ion-exchange method of winning uranium from acid leach liquors.	Dr. T. V. Arden, Chief Development Chemist, The Permutit Co., Ltd., U. K.
7.	Extraction of thorium and uranium from monazite sand and their refining.	Mr. H. N. Sethna & Mr. S. Fareeduddin, Atomic Energy Establishment, Bombay.

8.	Brazilian practice for Monazite Treatment.	Dr. P. Krumholz, *Orquima S. A.*, Brazil.
9.	Extraction of rare earth metals.	Professor Felix Trombe, Directeur du Laboratorire des Terres Rares, C. N. R. S., Bellevue France.
10.	Application of rare earth metals in metallurgy.	Dr. B. R. Nijhawan, Director, National Metallurgical Laboratory, Jamshedpur.
11.	Present status of zirconium metallurgy.	Dr. Brahm Prakash & Mr. C. V. Sundaram, Atomic Energy Establishment, Bombay.
12.	Present status of beryllium metallurgy.	Dr. T. Banerjee, Asst. Director & Mr. P. B. Chakravarti of National Metallurgical Laboratory, Jamshedpur.
13.	Developments in beryllium metallurgy with special reference to practice at the Brush Beryllium Co., U. S. A.	Mr. Carl W. Schwenzfeier, Vice-President, The Brush Beryllium Co., U. S. A.
14.	Present status of production of Metallic Uranium and thorium.	Dr. G. S. Tendolkar & Mr. S. K. Kantan, Atomic Energy Establishment, Bombay.
15.	Treatment of irradiated fuel elements and breeder blankets.	Mr. R. Manocha, Atomic Energy Establishment, Bombay.
16.	Recent developments in the pyro-metallurgical treatment of irradiated fuel elements and breeder blankets in U. S. A.	Dr. S. Lawroski, Director, Chem. Eng Div., Argonne National Lab., U. S. A.
17.	Physical metallurgy of uranium.	Dr. K. Tangri, Atomic Energy Establishment, Bombay.
18.	Fabrication and canning of uranium — British Practice.	Mr. L. M. Wyatt, Head, Metallurgy Sec. U. K. Atomic Energy Authority, U. K.
19.	Development in plutonium metallurgy.	Mr. M. B. Waldron & Dr. D. M. Poole, Metallurgy Division, Atomic Energy Research Establishment, U. K.
20.	Physical Metallurgy of Thorium.	Dr. M. K. Madhekar & Mr. M. K. Asundi, Atomic Energy Establishment, Bombay.
21.	Technology of rare metal oxides and carbides.	Dr. V. K. Murthy, Atomic Energy Establishment, Bombay.
22.	Special problems involved in sintering of beryllia.	Dr. R. Caillat, Dept. of Metallurgy & Industrial Chem., Atomic Energy Com., France.
23.	Powder metallurgy in nuclear engineering.	Dr. Henry H. Hausner, Nuclear Engg. Div. Penn-Texas Corpn. U. S. A.
24.	Present status of dispersion type fuel elements in U. S. A.	Dr. H. Weber, G. E. C. Knolls Atomic Power Lab., U. S. A.

PROGRAMME

SUNDAY—*1st December 1957*

9—00 A. M. to 10—30 A. M.		Registration of Delegates.
10—30 A. M.		Inaugural Address by Dr. H. J. Bhabha, F. R. S.
onwards		Presidential Address by Dr. K. S. Krishnan, F. R. S.

SYMPOSIUM ON RARE METALS

2—30 P. M.		*Resources of Rare Metals.*
to	— 1—	India's Resources of Rare Metals —by Dr. D. N. Wadia.
5—30 P. M.		*Beneficiation of uranium bearing ores and of beach sands.*
	— 2—	Review of beneficiation techniques pertaining to uranium bearing ores—by Mr. P. I. A. Narayanan.
	— 3—	Beneficiation of Indian uraniferous ores and beach sands—by Dr. R. Krishnaswamy.
		Treatment of uranium ores and ore concentrates.
	— 4—	The extraction and recovery of uranium ores from Australian ores—by Dr T. R. Scott.
	— 5—	Problems in the leaching and extraction of Indian low grade uraniferous ores—by Dr. J. Shankar & Mr. B. H. Krishna.
	— 6—	Ion-exchange method of winning uranium from acid leach liquors —by Dr. T. V. Arden.

MONDAY—*2nd December 1957*

10—00 A. M.		*Treatment of Monazite.*
to	— 7—	Extraction of thorium and uranium from monazite sands and their refining—by Mr. H. N. Sethna & Mr. S. Fareeduddin.
1—00 P. M.	— 8—	Brazilian practice for monazite treatment—by Dr. P. Krumholz.
		Production and Application of Rare Earth Metals.
	— 9—	Extraction of rare earth metals—by Prof. Felix Trombe.
	—10—	Application of rare earth metals in metallurgy—by Dr. B. R. Nijhawan.
		Present status of zirconium metallurgy.
	—11—	Present status of zirconium metallurgy—by Dr. Brahm Prakash & Mr. C. V. Sundaram.
2—30 P. M.		*Present status of beryllium metallurgy.*
to	—12—	Present status of beryllium metallurgy—by Dr. T. Banerjee & Mr. P. B. Chakravarti.
5—30 P. M.	—13—	Developments in beryllium metallurgy with special reference to practice at the Brush Beryllium Company—by Mr. Carl W. Schwenzfeier.
		Production of Metallic Uranium and Thorium.
	—14—	Present status of production of metallic uranium and thorium—by Dr. G. S. Tendolkar & Mr. S. K. Kantan.
		Treatment of irradiated fuel elements and breeder blankets.
	—15—	Treatment of irradiated fuel elements and breeder blankets—by Mr. R. Manocha.
	—16—	Recent developments in the pyro-metallurgical treatment of irradiated fuel elements and breeder blankets in U. S. A.—by Dr. S. Lawroski.

TUESDAY—*3rd December 1957*

10—00 A. M.		*Physical Metallurgy and Fabrication of Uranium & Plutonium.*
to	—17—	Physical metallurgy of uranium—by Dr. K. Tangri.

—18— Fabrication and canning of uranium — British Practice — by Mr. L. M. Wyatt.

1—00 P. M. —19— Development in Plutonium Metallurgy—by Mr. M. B. Waldron & Dr. D. M. Poole.

Physical Metallurgy of Thorium.

—20— Physical metallurgy of Thorium —by Dr. M. K. Madhekar & Mr. M. K. Asundi.

2—30 P. M. *Technology of Rare Metal Oxides and Carbides.*

to —21— Technology of rare metal oxides and carbides—by Dr. V. K. Murthy.

5—30 P. M —22— Special problems involved in sintering of beryllia—by Dr. R. Caillat.

Powder Metallurgy in Reactor Applications.

—23— Powder metallurgy in nuclear engineering—by Dr. Henry H. Hausner.

—24— Present status of dispersion type fuel elements in U. S. A—by Dr. H. Weber.

ELEVENTH ANNUAL TECHNICAL MEETING

WEDNESDAY—*4th December 1957*

10—00 A. M. — 1— Principles of Heat Transfer in the Fuel efficiency of Blast Furnaces—by B. I. Kitayev, Rajendra Kumar & S. G. Mukherjee.

to — 2— A note on the design of Regenerators—by P. R. Dhar, B. I. Kitayev & S G. Mukherjee.

1—00 P. M. — 3— Hydrogen in Steel-melting Processes—by V. Yavoisky & S. Roy.

— 4— Continuous casting of steel—by V. Yavoisky & P. K. Sen.

— 5— Aluminising of steel by the Aqueous Flux Process—by S. M. Arora, P. K. Gupte & B. R. Nijhawan.

— 6— *Martensitic Transformations* in Steels—by Rajendra Kumar.

— 7— A study of the early stages of tempering in a 0.2% C, 9% Cr and 0.38% V Steel—by A. K. Seal.

2—30 P. M. — 8— Role of carbides in Heat-Treatment of Steel—by G. Mukherji.

to — 9— Studies on Silico-manganese steel, Part I—Effect of Carbon content on Hardenability—by S. N. Asthana, D. K. Sood & T. V. Cherian.

6—00 P. M. —10— Studies on Silico-manganese Spring Steel, Part II—Effect of Quenching Temperature on Hardenability—by D. K. Sood & T. V. Cherian.

—11— Studies on Silico-manganese spring steel, Part III—Effect of Alloy Additions—Silicon and Chromium—On Hardenability—by D. K. Sood and T. V. Cherian.

—12— Studies on Silico-manganese spring steel, Part IV—Effect of Carbon Content on Flexure Properties—by S. Jayram, H. R. S. Rao, V. G. Paranjpe & S. Visvanathan.

—13— Studies on Silico-manganese spring steel, Part V—Temperability—by S. Jayram, H. R. S. Rao & V. G. Paranjpe.

—14— Some observations in Recrystallization and grain growth in Aluminium—by A. L. Malhotra & P. Dayal.

THURSDAY—*5th December 1957*

10—00 A. M. —15— Fibre texture of recrystallized aluminium wire—by P. Dayal & S. Dey.

to —16— Preparation of Titanium alloys by Alumino-thermic reduction, Part II—by use of Energisers—by R. A. Sharma, A. N. Kapoor & A. B. Chatterjea.

1—00 P. M. —17— Hot Cathode Technique for preparing Titanium—by H. N. Sinha.

—18— Production of some less common metals by fused Salt Electrolysis—by R. K. Mangal & H. N. Sinha.

—19— Friction and Frictional Wear—by B. N. Das & R. Choubey.

—20— Simultaneous determination of Copper, Aluminium and Magnesium in Zinc alloys for Die-casting by the Porous cupspark technique—by B. C. Kar, M. K. Gupta & V. Muthukrishnan.

—21— The Heat Capacity of Solid Solutions of Cadmium in Silver—by Ralph Hultgren & K. N. Rao.

2—30 P. M. —22— A new approach to the Synthesis of Metallic Hydrides—by S. Ramamurthy.

to —23— Deformation texture in Cold-drawn nickel rods—by K. Tangri.

6—00 P. M. —24— Plating on Aluminium using an Iron inter-layer, Part I—Application of an iron inter-layer with subsequent flash-plating of copper on brass—by D. S. Tandon & T. Banerjee.

—25— Plating on Aluminium using an Iron inter-layer, Part II—Application of an iron inter-layer without subsequent flash-plating of copper or brass—by D. S. Tandon & T. Banerjee.

—26— Plating on Aluminium using an iron inter-layer, Part III—Use of Iron inter-layer deposited from ferric chloride solution at temperatures lower than 95°C and without flash-plating of copper or brass—by D. S. Tandon & T. Banerjee.

—27— Determination of Equicohesive temperature—by R. V. Tamhankar.

—28— Some observations on the Portevin-Le Chatelier Phenomenon—by R. V. Tamhankar.

FRIDAY—*6th December 1957*

10—00 A. M. Onwards. Visits to Swimming Pool Type Atomic Reactor 'APSARA', new Canadian Reactor under construction and to Premier Automobile Works.

TAX ON RAILWAY PASSENGER FARES

The Railway Passenger Fares Act 1957, recently passed by Parliament for the levy of a tax on railway fares, came into force with effect from September 15, 1957.

The total proceeds of this tax would go to the States which needed resources to fulfil their targets under the Second Plan. The new tax is not leviable on passengers travelling for distances upto 15 miles (inclusive) or on those travelling on Season tickets. As regards other passengers, the tax is leviable at a certain percentage of the fare depending on the mileage of the journey. Passengers travelling for distances from 16 to 30 miles will pay a tax of 5% of the fare, those travelling from 31 to 500 miles, a tax of 15% of the fare, and those travelling over 500 miles, a tax of 10% of the fare.

The tax applies to all passengers irrespective of the class of travel. The tax will be collected along with the fare and will apply to travel over all Indian Government Railways as well as over company managed lines.

Production of Non-Ferrous Castings by the Indian Railways

*By *H. S. Sharma*

INDIAN Railways claim to be the largest single consumer of Non-ferrous metals in this country, particularly in the form of Bronze and Antifriction alloy castings. From an estimate of non-ferrous Castings produced by the entire railway system some three years back, it was computed that the railways produced some 17000 tons of castings in a year. It shall be no exaggeration to suggest that the present day production of such castings, shall be nearer to the mark of 25000 tons. If we have to convert this apparently harmless figure of 25000 tons into rupees, then on the basis of a very conservative average rate of i. e., Rs. 4000/- a ton, we arrive at a stupendous mark of Rs. 10.00 Crores.

It is further estimated that about 40% of the total casting produced involve the use of virgin metals. Thus nearly 4 crore of rupees worth of virgin metals must be imported to make the railways move smoothly. To-day when our country is faced with an adverse trade balance, it is imperative that the balance has to be restored. But we have set certain targets before us in the 2nd Five Year Plan, which must be fulfilled. The Indian railways have also their expansion programme, which must be carried out to enable it to shoulder the ever increasing responsibility of transportation. So this great contradiction in the industrial revolution of India, has set our leaders think aloud. They have already started slashing many a item from

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the plan and have clamped the curtain on luxury goods and restricted the import of even strategic items i. e., Non-ferrous metals. In this great endeavour, it becomes the duty of every citizen, to whatever walk of life he belongs, to find ways and means, whereby the required economy can be effected without halting the tempo of Industrial revolution, which is our set goal.

We, therefore, who deal with the requirement of railways for non-ferrous metals in one form or the other, has also a duty to perform. It calls for a little introspection, casting away of prejudices, a brave admission of our lapses and making a mighty effort to reach our goals.

Then let us peep into our workshops, who handle, in their day to day working millions of rupees of these indispensable precious metals.

Raw Materials: (Non-ferrous metals and alloys) Various Castings required for the locomotive, Carriages or Wagons are produced from well defined Indian railway specification covering the non-ferrous metals or their alloys. To obtain these metals and alloys the railways either produce it themselves or purchase it from the trade. Given the chemical constituent of an alloy, it would be a simpler job to make it from virgin metals but as the railway workshops turn out an enormous quantity of scrap, they are mostly made out of scrap material. Well, it is immaterial, as long as the casting confirms both chemically and physically to the desired specification, be it is made from scrap or entirely from virgin metals. After obtaining the alloy ingots it does not end there, the aim is considered to be fulfilled when the cast product corresponds with the specification and is a sound casting free of porosity etc.

How far this end is achieved is a doubtful factor! The author has had the occasion of visiting scores of railways, ordnance and other Govt. owned factories, including Railway workshops at Jodhpur, Ajmer, Dohad, Izatnagar, Lucknow (Charbagh), Gorakhpur, Liloaah, Goldenrock, Jabalpur (Gun Carriage Factory), Kharagpur, and Mysore. The impression that I could gather during my visit to these workshops, is this that while the railway administration exercises greatest care, when purchasing castings or alloy ingots from the trade, the zeal and enthusiasm fizzles out when it comes to obtain castings in their own foundries. I am sorry to lay down this sweeping remark but with my fourteen years of grinding with railways and their requirement of no n-ferrous metal alloys. I cannot but feel sorry for the national losses. The above is borne out from the following facts :—

The self-sufficiency and economy drive has made the railways to adopt the increased utilization of their own scrap for producing castings. This is being done in two ways (1) Utilising a part of the graded scrap by mixing it with the alloy ingots of known specification (2) Converting the scrap material into ingot form and then remelting it with the addition of fresh virgin metal, till it confirms to specification.

Now, on the paper the above proposition looks quite sound but as a matter of fact in practice it is almost unworkable. For instance the addition of segregated scrap (i. e. upto 25%) of Phosphor Bronze N6/49 Class I, to a charge consisting of balance 75% of alloys ingots, is an intelligent and economic suggestion, provided the said segregated scrap is a guinine collection of Phosphor Bronze of IRS. N6/49 Class I. The so called segregated scrap of Phosphor Bronze is invariably a mixture of mixed metals, which may include Brasses, Leaded Bronze and like. Who cares or bothers to find out in the foundry, whether the Phosphor Bronze scrap issued from the stores does have any semblance with the real Phosphor Bronze? Does the person responsible for segregation have sufficient knowledge to declare the composition of castings by visual or fracture test? No person, however, experienced can precisely predict the composition of mixed castings. It clearly shows that without a chemical testing the segregation of scraps can be approximate and not exact. Thus the resultant mixture of such scraps and alloy ingots shall definitely disturb the balance of the alloy, which is so rigidly bound by the I. R. S. Specification. The Phosphor Bronze N6/49 Class I. limits the usual constituent of Bronze alloys to very rigid limits i. e., the zinc and lead should not accede 0.5%, the Phosphorus contents can vary within close limits of 0.4/0.6. It is therefore, evident that very little respect is intended for IRS. Specification. The castings are continued to be produced in the same vein with lead and zinc contents bounding off their limits from anything 100 to 300 per cent.

Are these castings rejected for failure in chemical test? I have my own grave doubts about it, as this practice is prevalent in all the workshops.

In one of the large railway workshop of the South, large scale consumption of old railway castings is being made. In their usual small morgan crucible furnaces, bronze confirming to IRS. N6/49 Class II is being produced. The heats were melted and cast on the basis of predetermined charge compositions. About 50% of the old scrap was being used and the balance

made up from virgin copper, tin and zinc. On enquiry, about the resultant composition of the alloy, it was reported that lead content often goes up to 2/3% and the tin 8/9%, while it is specified only 1.5% max. lead and 7% of max. tin.

Now, it is understood that the railways have taken up the complete refining of swarf borings to IRS. Specifications, in some of their workshops. The borings that come out of the railway workshops are broadly classified as under :—

(a) Purely leaded Bronze borings.

(b) Mix. borings of non-leaded, leaded bronze, white metal, brass and other metals.

Here again the railways are presumably faced with greater and more complex production problems, when compared to producing castings from alloy ingots.

These are—

1. Lack of bigger melting units and other specialised melting and refining plants.
2. Lack of the manufacturing know how, so much essential for the economic operation.
3. Lack of coordination and underestimation of the financial implications involved in the refining business.

On the actual production side, the swarf borings are usually contaminated with unwanted metals and the cleanest of them all contain a proportion of brass and white metal turnings too. The only equipment in the armoury of railway foundry is the usual morgan Crucible Furnace of 400 Lbs. capacity through which an attempt is made to remove the impurities and obtain alloy ingots to I. R. S. Specifications. The refining of borings and mixed swarf is wholly an uneconomic proposition, without proper equipment, planning and specialised knowledge, so much necessary to run the plants efficiently.

The present day set up of the railway foundries is hardly conducive to obtain standard quality castings, which can only ensure a longer life for our locomotive and rolling stock. And in the midst of their existing difficulties, it will be suicidal to burden the foundries with the job of reconditioning scrap material.

The refining job is not completed by planting a number of melting units, equipment and laboratories. This is a job, which involves too much of a personal factor and financial implication, in which very judicial action of experts is required at every stage, in the gradation, dressing, melting and refining operation. If the railways are so keen on doing their own refining and reclamation work, they have got to evolve an entirely independent organisation. This organisation must be based on a joint enterprise of both private and government interest. The private sector has scores of years of experience of refining jobs and they can provide the necessary technical know how, equipment and finance.

Reverting to the subject of producing vital bronze castings for the railways, let me warn that the present day weakness and latitude towards not strictly adhering to standard railway specification is a very unhealthy sign and spells of greater disaster both financial and otherwise.

The Railway foundries should produce castings, which have optimum of physical properties and deviation from chemical composition is a trend in the opposite direction. As suggested above the utilisation of scrap and swarf must be left to the guidance of a separate organisation manned by experts. The production of a perfect casting is not a simple operation of melting and casting alone. It is well known that a perfect alloy ingot, if melted in a reducing atmosphere or charged with moisture content or kept in a molten state for longer time, shall result in its becoming gassy or even loosing some of the constituent metal, and producing gassy casting with hardly 30% to 40% of the desired mechanical property. Again there is a technique in the pouring of the molten metal in the moulds. If the metal is not poured at the correct pouring rate and temperature, it shall produce weak castings and rejection due to shrinkage etc. shall be heavy.

Metal losses in melting and casting is another important matter to be reckoned with. But this too is neglected factor in the railway foundries. There are practical limits to the metal losses resulting from the melting of ingot material and then why these standards are not strictly observed? For instance Phospher Bronze Class I should not loose more than 0.75% Gunmetal IRS/N649 Class II, III and IV not more than 1%. In railway foundries the melting loss account never touch these standards and it may register

(Continued on page 56)

TRAINING OF WELDERS IN INDIA

*By *D. S. Honavar,* B. Sc. (Hons.), B. Sc. (Tech.), A. M. I. I. M.

FREE India is marching towards industrialisation. The first Five Year Plan placed us firmly on a path of progress in this direction. We have to move fast if we are to attain a standard comparable to that of western nations. This applies to all branches of industry and so does it apply to "Welding Industry".

Metal-Arc Welding is gaining rapidly in popularity. Indian industries do not have to look up to the foreign suppliers for their requirements of arc welding electrodes. They are now manufactured in India. But welding calls for trained and efficient welders in addition to good electrodes and equipment. This particular aspect raises an important problem, viz. training of welders, which, in turn, requires a training school and a carefully laid out course. An attempt has been made in this article to put forth the various subjects which need to be incorporated in a training programme for welders, dealing mostly with the theoretical part of training.

When the conditions in this country are taken into consideration, one fact which needs emphasis is that the trainees will not only include fresh students who want to take up welding as a career, but also persons who have worked as welders for sometime, without, of course, the requisite knowledge. These welders are likely to have wrong notions about several aspects of the subject and the training should serve of help the welders to revise their ideas and grasp the true picture of the subject. Consider, for example, the term "steel". Many welders are not aware of the true meaning; they are apt to take the term as a generality.

BASIC INFORMATION ON ENGINEERING METALS

Inasmuch as the majority of engineering structures and machines in which the joining is accomplished by welding, are made from steel of some type, it seems logical that the trainee be given a sound background on this material. Studies of this nature should precede any attempt at actual arc manipulation. When it is realised that the term 'steel' is not a generality, some of the difficulties encountered by welders will be solved. The welders have to learn that there are a great many different types of steel, each of which has its individual composition and its own physical and mechanical properties. Welding is to be considered in relation to the effects of the thermal treatment involved on each type of steel, or, in other words consideration of their 'weldability'.

(Continued from page 55)

any figure up to 10%, without rousing suspicion. The surplus metal is left over in the crucibles and sticking to tools etc. .. .. the liquid metal is deliberately spilt over the moulds, which cools down into small globules and finds its way into the refuse wagon. Excess metal is skimmed out with metallic slag and meets the same fate. Lacs of rupees of valuable metal is thus lost annually and nobody seems to bother about it. Sometimes it is sheer neglect and carelessness and often it is intentional.

Yet another important point in the production of bronze castings is the design of the patterns, whereby minimum practical machining is aimed at. A glance at the colossal amount of machined borings produced by each workshop is a striking proof of the failure and neglect on the part of design and pattern shop to provide correct patterns. There are workshops which convert twentyfive per cent of their total castings into borings and swarf.

In an era, when nations are engaged in the successful pursuit of reaching the stars and planets, we are still struggling to learn and practise the fundamentals of producing good castings economically. Let us not be so selfish, let us be worthy citizens to reach the goal assigned to the nation in the second five year plan. All of us, be a furnace operator, a moulder or a research worker, have got to be extremely conscious of our responsibilities. We have got to inculcate a feeling of dearness for our jobs and feel proud of our achievements. Then only we can lead our country to progress and prosperity.

* Research Chemist, J. B. Advani-Oerlikon Electrodes Private Ltd., Bhandup, Bombay-40.

GOLDEN RULES OF CONDUCT FOR RAILWAYMEN

1. Maintain proper relations with officers and others in the Department in which you work.

2. Use good human relations in your contact with subordinates. Do not make them feel their position.

3. Maintain good public relations with callers and passengers.

4. Be resourceful and find ways and means of doing a job well.

5. Discard the idea of 'Give me some more men to do the job'.

6. Learn the art of getting along with people.

7. Remember the most important thing is to get a job done—not just to do it anyway and somehow but to do it efficiently, safely, economically and expeditiously.

8. Develop the attitude of 'Give me plenty of rock and plenty of wood and just get out of my way'. This typifies loyalty and enthusiasm for work and responsibility.

★ ★ ★

1. Get down to the man on the JOB.

2. Move on the line as often as you can as MEMBERS OF THE PUBLIC and not only as officials.

3. Remember pre-arranged and announced expeditions cannot have the same informative value as surprise inspections.

4. Every railwayman has to be convinced that the work that he does is to his own advantage. He should not think and measure his effort merely in terms of wages which is only a motive force.

5. Every railwayman does a specialised job which has no meaning or usefulness by ITSELF unless it is cohered with each other. There is no meaning or value to the work of a permanent way gang unless there are trains to run over the track.

Welding as a process is a general term; whether the welding is done by an electric arc or a flame, by electric resistance or thermite method, heat is applied to the metals to be joined. Thus, although the primary objective is that of joining the metal parts, the process inevitably involves heat treatment which may vary in its extent in each case. It follows that an understanding of the principles underlying the heat treatment will enable the welder to make an intelligent appraisal of what is happening.

ELECTRODE CLASSIFICATION

The A. W. S. and BEAMA codes in electrode classification have proved of immense value to industry. It is thus possible now to specify the type of electrode for a given application without regard to the brands in the market. The trainee should learn these electrode classifications and their characteristics, such as type of coating, polarity, suitability for different welding positions etc It is only then that he can judge correctly the usefulness of any particular electrode or the superiority of one type over another in respect of the job in hand. It is common experience in India to-day to find welders who, after having been used to handling of one brand or type, for a decade or two, refuse to believe that there can be any other superior electrode and are inclined to reject it outright when approached with one. And yet the average welder is not to be blamed. After all he has been told and has come to believe honestly that the electrode he has been using for years is the best possible. Most of the welders are obsessed with the idea of "one electrode for all jobs", because interested persons may have put it into their heads. The average welder is not aware of any principles involved and therefore accepts as true what he is told by persons who think only of their sales irrespective of the interests of the industry as a whole.

It is obvious that this notion among Indian welders stands as an impediment in the progress of industry, both the welding industry and related ones. It should also be realised that the welder is not responsible for this stalling of progress for the simple reason that he has not received adequate training on scientific lines, is ignorant of the principles involved and has been accustomed to only one or two brands of electrodes for years together. When it comes to handling a new type, with slightly different characteristics, but far superior, he is inclined to reject it on the consideration of the failure of the electrode to satisfy his tastes. He is reluctant to adapt himself to the new electrode type.

The welding industry is thus deprived of the advantages gained from the latest developments in electrode design. To cite just one instance, the introduction of low-hydrogen electrodes in the Indian market may be mentioned. The development of low-hydrogen electrodes has revolutionized the science of welding and has widened the scope of arc welding to fields where only a few years ago, metal-arc welding was in the realm of the 'impossible'. But this electrode type met with stiff resistance from protagonists of the conventional types and of 'one electrode type for all jobs' theory, for considerable length of time, before it was accepted as a solution to some of the major problems in arc welding. Proper understanding of the various classes of electrodes will clear up many a misconception. Knowledge of this nature is much more fundamental than trade names and proprietary designations. It appears a disservice to industry to teach welding from the viewpoint of trade names for equipment and apparatus. But it is doubtful if such a thing can be avoided in view of the fact that manufacturers are concerned about competition and the training of welders provides a useful tool of tremendous value to the popularisation of their products.

Source of Electrical current :

This is another salient part of welder training. The subject should be presented on its merits rather than from personal prejudice as frequently happens. Direct current welding was in favour prior to and during the last war, but since then A. C. has progressed. The shortcomings of the A. C. have been overcome. The arc-striking difficulties encountered in A. C. welding have been eliminated. The capabilities of these two major arc welding methods should be presented to the trainee as also their drawbacks.

Arc Manipulation Ability :

Welding is primarily manual work. Although the welding school is expected to impart theoretical knowledge of his work to the trainee, the most important function of the school is to train the student to acquire a certain degree of manipulative skill. This skill involves more or less complete control over the pool of molten metal into which the filler metal flows under his guidance.

Recent advances in electrode design have resulted in reducing the importance of this ability. "Contact Electrodes" represent this new development. These electrodes do not require any manipulation since the electrode need only be touched to the parent metal.

Ability to manipulate the arc that will develop sound weld metal is, of course, the ultimate test of an accomplished welder. Since welding is done in several positions, the trainee needs to develop manual dexterity to a high degree. This calls for constant practice by the trainee in various positions of welding. Most of the trainees will be found eager to produce a weld bead of pleasing appearance, neglecting at the same time the weld quality. Hence the need for making the trainee quality-conscious. Weld bead appearance is, no doubt, important, but should not be attempted at the cost of weld quality. The trainee has to strive for weld metal free from contamination and under-cutting at the weld edge. The emphasis should be more on soundness of weld metal and joint penetration than on weld appearance.

Safety precautions—Safe practices :

No training in welding and, for that matter, in any industrial occupation, can be considered to be complete, if it fails to inculcate in a welder a sense of awareness to the dangers. It would be readily conceded that ignorance on the part of the welder will in itself constitute a danger to himself as well as his co-workers and the equipment around him. Lack of their understanding of the hazards will thus be a constant liability he will carry with him. Hence lessons on Safe Practices and Health Precautions should form not just a part of the course, but an early part of it so that during the period he is under training, he learns to observe these precautions with due attention.

INSTRUCTORS

The key to the success of any training programme is ready availability of a qualified instructor. The importance of this person cannot be over-estimated. Whatever the standard of equipment, course of study and instructional material, it is ultimately the instructor who has to utilize these facilities to transform trainees into competent welders. Two types of instructors seem necessary, viz. for class room lessons dealing with theoretical aspects of welding and related subjects, and for practical lessons in welding. Both must be fully qualified in their respective fields to meet the needs of the trainees. It may be considered good practice to have separate instructors as stated above for the simple reason that it is difficult to find a person who will completely satisfy the requirements of both the categories. And yet it stands to reason to say that the outcome of the efforts of the school will be as good, if not better, when one and the same person can efficiently perform the duties of the two types. The reason is simple. Since the same person guides the trainees in both the sections, he thereby helps to maintain a continuity which cannot be established with two instructors.

Qualifications Tests and Codes of Minimum standard :

Metal-arc welding is to be regarded as a combination of an art and a science and hence the individual equation enters to a greater extent in metal arc welding than it does, say, in automatic spot welding. The trainee should be introduced to the subject of codes and specifications so that he will gain an appreciation of the qualifications that will be expected of him. It is thus that he will be in a position to give due attention to the various aspects in order not to be found lacking in some of them. He can have a clear idea of the standard he has to attain. One point which need be mentioned in this connection is that it is difficult to prescribe codes of minimum standard which will embrace all the welding jobs; in other words, a welder cannot be certified for every demand within his field, although it would be a great service to the welding profession if such a scheme can be worked out. The welder is confronted with the necessity of requalifying for each different job and/or material and he might wonder why he should have to submit himself to these tests every time he takes up a new welding job. Well, until such time as the all-embracing codes are made available, he has to be prepared to stand for requalifying tests. Hence the need for appraising the trainee of the situation he will be called upon to face from time to time in his career.

It will be worthwhile to mention here that when a welder trainee has completed the course of study in the school, he is not to be considered a skilled welder. He needs to put in a lot of hard work under shop conditions. Now these shop conditions will be of diverse nature because of the variety of applications, possibly differing considerably from the lesson in the school, with the result that the freshly trained welder may find himself almost a beginner in the job in question. Yet, the knowledge, especially the practical part of it, gained in the school will certainly have prepared him to approach any welding job with confidence. To put the whole thing in a nutshell :

The training school serves as a stepping stone to success as a welder. Proficiency in field-work and job shops will be the fruit of additional efforts based on the initial training received in the school.

(Continued on page 60)

Surface Alloying in Brazing and Related Technique

(Contributed by Larsen & Toubro Technical Service)

INTRODUCTION

THE study of the union of two metals is a fascinating subject which has received considerable attention. So far no completely satisfactory explanation has been given of the mechanism underlying bonding of the two metals.

The mechanism of metallic bonding is primarily related to attraction forces between atoms of the two metals. These forces are also associated with the electron configuration of the metals involved. Metallic bonding is aided by diffusion, which is the movement of atoms within the molten metal—usually from regions of high concentration toward regions of low concentration. The rate of diffusion in metal is normally considered to be a function of pressure, temperature and concentration. If the temperature of metal is raised, the diffusion rates are increased and ability to form metallic bonds is facilitated, as for example, in the welding together of two bars of iron raised to the required temperature.

It would seem that there are gaps in the atomic structure, more than sufficient to accommodate the passage of many other moving atoms.

BRAZING

Bonding two similar or dissimilar metal surfaces with a filler metal that has a melting point above 800°F., but lower than those of the metals being bonded is termed "brazing".

In fusion welding both edges of the metal are melted and are allowed to run together with or without a suitable filling material. In brazing the edges of the metal, being joined, are *not* brought to the melting point; but, a low-melting alloy is introduced between the edges of the metal being joined and when the temperature is raised sufficiently a 'tinning' effect

(Continued from page 59)

If the above observations point to anything, it is the need for co-operation between the industry and the school. The school will arrange the preliminary training for the students and the industry can provide the additional facilities required such as for apprenticeship in their workshop as part of the course of study. Thus will the student acquire useful knowledge of shop conditions. Furthermore, the welders, after passing out from the training school can be taken up by industrial firms for training on specialised jobs and later on absorbed in their employment. This will help meet the requirements of the industry for skilled welders. Who can deny; "the welder who works with his hands alone is at a disadvantage in competition with one who works with his hands and his head"?

The training programme should aim at producing the latter class of welders. The welding industry in India needs such a programme to-day. The purpose of this article is to focus attention on need for training schools and also on the fundamentals that are necessary for a sound welder training programme. When these fundamentals are understood, it should not be difficult to plan the training on right lines.

CONCLUSION

A lot needs to be done to raise the standard of Indian Welders many or most of whom are called welders by virtue of their having learnt through years to carry out a few specific jobs. Let us then approach the problem with the care and quickness it demands.

It will be in the fitness of things if reference is made here to the efforts of the welding sub-committee of the Indian standards Institution to develop this branch of science in India; the efforts are indeed praise-worthy. The sub-committee is at present engaged in work relating to publication of a "Handbook for Welders" which will be of immense value to the welding industry in general and the welding profession in particular. It is gratifying to see such interest being taken in their advancement. Besides, the welder-training schools, already in existence, such as those at Chittaranjan and Perambur can be mentioned to show how usefully such training centres serve the industry. The people connected with the welding industry and for that matter all who have at heart the interests of Indian industry in general, owe it to themselves to contribute to the success of all such efforts.

takes place and a joint is produced by adhesion. Most brazing processes are conducted open to atmosphere with the aid of satisfactory fluxing methods; or in a controlled gaseous atmosphere. The filling metal, when molten and in contact with the metals that are being joined and have been raised to a suitable temperature, adheres to the surface by virtue of surface tension and produces the 'tinning effect'. Satisfactory "Wetting" of the metal surfaces by the fused filler metal is one of the pre-requisites for ensuring strong metallic bonds. The alloy characteristics of the filler material appear to determine their wetting qualities or the ability to spread.

THE EUTECTIC ALLOYS

An alloy in a metallic system which possess the lowest transformation point on passing from solid to liquid is called "Eutectic".

Brazing or welding, if carried for excessively long periods at high temperature, may lead to serious deterioration, such as excessive grain growth, porosity, burning etc. EUTECTIC brazing compositions tend to minimize these objectionable physical properties because they solidify or freeze quickly from the fused or molten state.

In solidifying from the fused state, they do not pass through a range of temperature were both solid crystals and liquid phases occur simultaneously prior to complete freezing. However, the use of pure eutectic compositions is often not practical since excessive quenching strains may result in cracking. To minimize these defects, alloy compositions approximating to the eutectic composition are used to provide improved brazing properties. These alloys due to their low melting point, require much less heat input during a bonding operation; thus they far surpass other alloy mixtures which exhibit undesirable post bonding results.

SURFACE CONDITION

In metallic bonding the preparation of the surfaces is of major importance. The surfaces of commercial metals are usually covered with films of varying densities and compositions. Chemical analysis has shown that these films consist mostly of oxides and, in addition, may contain other materials such as sulphides, sulphates and carbonates. The oxide film acts as a barrier in brazing and must be remove either chemically or mechanically to permit satisfactory metallic bonding.

There are three major methods of cleaning metal surfaces prior to brazing. These are: (1) fluxing with salts that dissolve and absorb the oxide films; (2) reducing the oxide films with reducing gases; (3) immersing in molten baths of flux that combine both absorption of the oxides and an oxide-reducing action. To do a satisfactory job, the molten flux must possess proper physical as well as chemical properties. The flux should blanket the brazing alloy upon liquefying, thereby minimizing oxidation. It should be sufficiently viscous to serve as a blanket and not run off or spread too thin. It should also be clear to allow the operator to examine his work. This last property is convenient but not absolutely essential.

A good flux should be durable, water soluble and capable of being applied by brushing, dipping or spraying methods. In addition, it should wet the metallic surfaces and should not streak or spread in lumps.

Oxides and other contaminations on the base metal and brazing alloy should be dissolved and absorbed by the molten flux. The unsaturated portion of the flux should be adequate to permit through metallic cleaning during the brazing operations. A clean surface can also be obtained by reducing the oxides to the metallic condition.

NEW FLUXES WITH DETERGENTS

Certain chemical compounds possess the properties of reducing the surface tension of liquids, enabling them to wet completely foreign surfaces. They are called "detergents". Similarly, certain activating compounds are often added to brazing fluxes, enabling them to produce similar effects. A well-balanced flux usually contains fluorides, chlorides, borates and small quantities of these activators. The flux should have the following characteristics:

1. produce no excessive run off,
2. melt at temperatures below the melting point of the brazing alloy,
3. reduce or dissolve the oxide films,
4. wet completely both the base metal and the brazing alloy,
5. protect the base metal against oxidation during heating,
6. activate or clean the surface prior to brazing,
7. be displaced by the brazing alloy when liquid.

ACTIVATION OF SURFACE

Activation of a metallic surface is most important for good metallic bonding. We have seen how two Johanssen blocks, when brought into intimate contact, have exceptional holding power. We may term each block as having its surface activated to permit strong metallic forces to be brought into action. A good flux behaves similarly.

As the atoms at the surface of a base metal are thermally agitated by heat all foreign matter is removed by means of the molten flux. Thus the virgin metal becomes exposed, permits the molten brazing alloy to diffuse or penetrate into the base metal. This results in the formation of strong bonds.

NEW OBSERVATIONS IN BONDING

Strong metallic bonds by brazing are possible when a rapidly diffusible metallic layer is deposited on the base metal prior to brazing. The resulting accelerated diffusion of results in strong bonds. These intermediate layers of monatomic metal may come from the filler rod or from the flux mixture itself. The flux may contain metal ions which can be reduced and deposits upon the base metal. The deposition occurs at temperatures far below the melting points of the brazing materials. The deposited layer has the opportunity to diffuse into the base metals. This is especially true when the deposited ions are low melting elements, easily alloyable to the base metal. In this manner, brazing takes place readily, because: (1) The diffusion occurs into automically clean surfaces having high surface mobilities; (2) The two surfaces of the base metals, alloy with the fused brazing material by means of a low melting interface. These metal ions are important brazing carriers and the layer deposited follows the law governing the electromotive-force series.

CONCLUSION

In summation, we find that strong metallic bonds by brazing depends upon the degree of diffusibility of the metals, which in turn is a function of pressure, temperature and concentration. The surfaces of even compatible metals must be treated before they can be brought into a condition favouring diffusion and the formation of strong metallic bonds. This treatment can be accomplished by mechanical means, specific atmospheric treatment, chemical reducing action or by the use of scientifically designed fluxes.

The process of "surface alloying" or "tinning" by the alloy was adapted to the bonding of metals at a heat below the melting point of the base metal by J. P. H. Wasserman in 1906. Research in this field was continued by his son, Rene D. Wasserman, who, in 1940, established the Eutectic Welding Alloys Corporation in New York. Thanks to this Research in Metal Joining Process, it is now possible to bond metals below their melting temperatures by "SURFACE ALLOYING TECHNIQUE".

It is hoped that this technical presentation helps in the understanding of the basic principles underlying the distinctive characteristics of the welding alloys manufactured by this firm.

INAUGURATION OF COMMITTEE OF ENGINEERS FOR BOMBAY STATE

The Inaugural meeting of the Committee of Engineers for Bombay State for Railway-affecting and other public works was held at Sachivalaya, Bombay, on 24th August, 1957. Shri M. Ganapati, General Manager of Western Railway, was present by special invitation.

This committee was recently formed under the Chairmanship of Shri U. N. Mahida, Chief Engineer, Public Works Department (Irrigation) with the Deputy Secretary for Local Self-Government, the Chief Conservator of Forests and Chief Engineers of the Western and Central Railways as Members.

A decision to form such committees in all States was taken following discussion by the Minister of Railways with the Chief Ministers of various States.

LIST COMPILATION

After explaining the objects of the Committee, Shri Ganapati said that the committee would first arrange to compile a list of all railway-affecting works and suggest way to ensure their periodical inspection and also for keeping them in a good state of repair.

He emphasised the need for close co-operation between the various departments in order to ensure that the money spent was well spent and adequate safety had been provided.

Shri U. N. Mahida, Chairman of the Committee, stressed the importance of the safety factor in all undertakings and stated that close co-ordination between various departments would not only ensure safety but also lead to economies. He pointed out that they were embarking upon a new approach to the problem of safeguarding the assets of the various departments so as to ensure protection to property and life.

CRANES OF ADVANCED DESIGN FOR INDIAN STEELWORKS

DEMONSTRATION GIVEN BY BRITISH FIRM

Demonstrations illustrating many advances in design have been given at the works of a British engineering company which has recently completed orders for self-propelled and rail-mounted cranes for the new Indian steelworks at Durgapur and other Indian iron and steel plants.

A four-minute operation by one crane involved the hoisting of an overhead travelling crane weighing 10 tons to a height of 35 ft. and then, with great precision, placing it delicately upon the tracks. The crane was a 25-ton-capacity, self-propelled type fitted with a 60 ft. strut jib.

On all the cranes used in the demonstration, the Diesel-electric transmission system was featured. This consists of a Diesel prime mover driving a shunt-wound generator which, in turn, supplies current to separate motors for each of the crane motions. It is stated that one great advantage of this system is the resulting reduction in fuel consumption, since the engine is not kept running at high speeds, power being developed according to needs.

This variable-voltage system provides an infinite variation of speeds, smooth acceleration, controlled lowering under power, and a high degree of accuracy. As an indication of the degree of precision, a five-ton-capacity crane lifted a steel tube and lowered it into another with such fineness of control that it did not unbalance or move in any way. There was only one-eighth of an inch clearance between the two tubes.

The British company concerned (Steels Engineering Products Ltd., of Sunderland), besides the seven cranes supplied for Durgapur, has delivered one self-propelled crane for the Indian Iron & Steel Co., of Burnpur, two rail cranes for the Tata Iron & Steel Co., of Jamshedpur, and several others for constructional companies carrying out work at Indian iron and steel plants.

* * *

U.K. FIRM TO SUPPLY 3,000–VOLT ELECTRIC LOCOS TO INDIA

The first 3,000–volt electric locomotives to be commissioned for service in India, it is announced in London, will be supplied by the English Electric Co. Ltd., which previously provided the South Indian Railway with its first electric rolling-stock and is, therefore, working on familiar ground.

The new locomotives, made for a maximum service speed of 70 mph, will be used for express and passenger trains and also for goods trains.

This type of locomotive especially designed for India has an up-to-date, streamlined look. With a driving-cab at each end, fitted with buffers and a cattle-guard, the locomotive can be driven in either direction. Two pantographs — sprung metal frames — make contact with the electric wires overhead.

The superstructure, which is constructed from rolled steel with all joints seam-welded, has a smooth and pleasing appearance. All the electrical equipment, with the exception of traction motors, pantographs, and lightning-protection equipment, is mounted in the superstructure.

* * *

ISI LICENCE FOR ALUMINIUM MANUFACTURING CO.

The Indian Standards Institution has granted one more licence to the Aluminium Manufacturing Co. Private Ltd., Calcutta, for the use of the certification marks of the ISI on wrought aluminium utensils. The number of such licences granted to the aluminium industry now reaches 15.

The following standard marks, consisting of the monogram of the Indian Standards Institution superscribed by the number designation of the Indian Standard together with the relevant grades of the material, will indicate that aluminium utensils manufactured by the firm satisfy all requirements for the respective grade given in the Indian Standard Specification for wrought aluminium for utensils, IS : 21–1953 :

Aluminium utensils are being increasingly used in the household in the country and India has also developed an export market for them in the Near East and the Far East.

To ensure a standard quality of aluminium utensils, the Government of India has banned the export of aluminium utensils not bearing the Standard Certification Mark of the Indian Standards Institution.

Diesel Railcar for Swedish State Railways

Compiled by AB Svenska Jarnvagsverkstaderna,
Linkoping, Sweden

A QUARTER of a century has now passed since the Swedish State Railways began to prepare the light, fast railcars as a replacement for trains hauled by steam locomotives on non-electrified lines.

These first railcars made an aluminium-covered superstructure of wood on an underframe of steel, the design being taken from road buses of that time.

But already in the years before world war II, a number of collision-proof all steel diesel railcars could be taken in service, the war, however, causing an interruption in the dieselization programme. After the war all the steam trains on the non-electrified lines have been replaced by diesel railcars, very often coupled together to train units, in which way great advantages have been gained both from operating and economical points of view. Among these advantages, in comparison with trains driven by steam or diesel locomotives, should be mentioned superior traction dynamics as well as the fact that the multiple-unit diesel train offers the great economy of flexibility. The superior traction dynamics comes from a better adhesion relation, i. e. a larger part of the total weight of the train lays on the traction wheels and, furthermore, the diesel railcar can generally be designed to have a greater effect per ton of train weight, meaning that the diesel railcar train can accelerate faster and get a higher average speed than the train driven by a locomotive.

Fig. 1. Diesel railcars for Swedish State Railways.

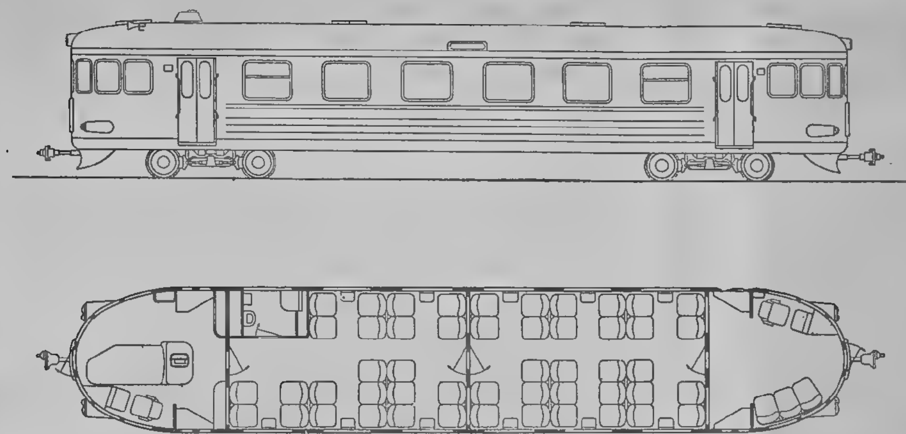

Fig. 2. Principle drawing of the railcar.

Fig. 3. Interior of steel body.

A great economy of flexibility is attained by the distribution of the traction force on several units and by the use of remote electric contacts, in which way the capacity of the diesel railcar train can easily be adjusted with regard to the varying requirements. This means a better use of men and material as well as savings as to fuel and maintenance.

In this connection perhaps ought to be mentioned the high importance of the modern easy and fast diesel engine with direct injection and with a supercharger, this type of engine being very much appropriate when designing railway equipment with small costs for operation and maintenance.

As the Swedish State Railways are carrying out a considerable programme for railcars, especially diesel-driven ones, the Swedish railway industry has acquired a very good experience in designing and building modern, light but collision-proof railway vehicles.

We think that our railway friends in India are nterested in a short description of the type of diesel

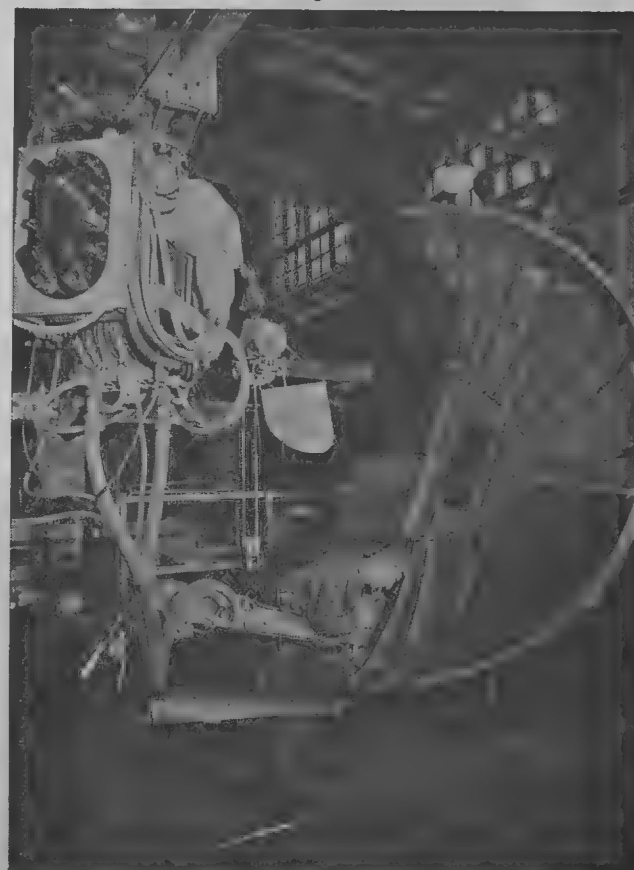

Fig. 4. Spot welding of end of roof.

railcar, a great number of which has been bought by the Swedish State Railways during the last five years and of which our company has hitherto delivered abt. 200 units.

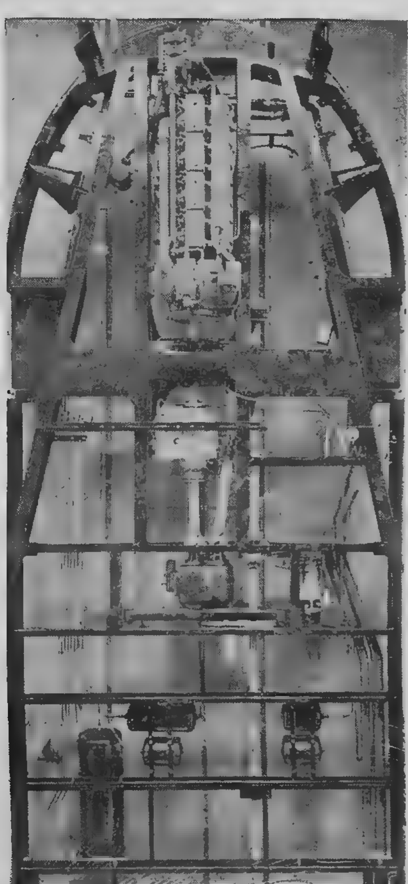

Fig. 5. View of the underframe with diesel engine and gear boxes.

These cars have fully complied to the requirements of the State Railways, having made service in very different climatic conditions from a summer temperature of +90° F to arctic climate north of the Pole circle, where the temperature in winter can sink to −50° F.

This railcar is an exquisite achievement in the field of light-load traction. Meant for suburban and cross-country services, it has been designed for speeds as high as 72 m. p. h./115 km/tim./, giving satisfactory service on all track conditions. In spite of high passenger capacity, the car is one of the lightest among the rolling stock of this size ever produced.

The outside view of the railcar is shown on figure 1, and figure 2 indicates the interior arrangements with one vestibule in each end of the car with driver's equipment and space for luggage. There are two passenger compartments.

Main data :

Track gauge	1.435 m.
Length over ends	16.55 m.
Breadth	3.1 m.
Height of car above rail	3.24 m.
Height of floor above rail	0.88 m.
Distance between bogie centres	10.7 m.
Distance between axles in bogies	2 m.
Weight in working order	17.4 ton.
Number of seats 2nd class	53
Engine	205 hk.
Number of traction axles	2
Maximum speed	115 km/h

Fig. 6 and 7. Interior of passenger compartment.

Fig. 8. Interior of toilet.

The sides, ends, roofing, and underframe of the steel body form a self-supporting unit in a light integral design. The underframe consists of pressed steel profiles joined together by arc welding. Sides, ends, and roofing are manufactured in complete units mainly by spot welding and strengthened by ribs and posts of z-profiles. The joining roof (walls and walls) underframe is made by means of riveting. The weight of the steel body is only 3.5 tons. The design of the steel framework can be seen on figure 3, 4, and 5.

The insides of the walls are clad with Formica boards or similar, and the roof of painted wall board. Space between the ceiling and roof, as well as between inside and outside walls is filled with Isoflex, a plastic material, or glass fibre panels for temperature insulation and for accoustic purposes. The floor is laid with linoleum or rubber mats on plastic glued ½" plywood resting on wooden beams on a steel underframe. Under the plywood there is a layer of Isoflex or glass fibre panels on a wallboard sheet.

The entrance doors, of an all pressed steel construction, are placed in each of the driver's cabs. They are of the folding type, automatically operated by door machines working on the compressed air system. The doors can be operated either from inside or from outside of the car and the driving gear provides control to prevent the opening of the doors when the car is in motion. The doors in the ends of the car are of the swinging type, turning outwards, and the doors between driver's cab and passengers compartment are turning to both sides.

All windows have double glass and the front windows are equipped with safety glass. In each passenger compartment there are two openable windows of the half-drop type. All the window panes are fastened by means of rubber profiles.

The seats are made of enamelled steel tubes and furnished with seats and backs of foam rubber, which are clad with specially made fabric. The cars are provided with other amenities for passengers such as tables, ashtrays, luggage racks, curtains, etc.

The toilet is fairly spacious, self-flushing and well equipped.

The interior of the car will be seen on figure 6, 7, 8, and 9.

The interior lighting of the passenger compartments is supplied by 1000 V 50 c/s cold cathode tubes mounted in two rows in the ceiling in shock proof mountings. Each end of the car is provided with one headlight of 50 watts and two sidelights of 50 watts each.

Fig. 9. Driver's cab.

The car is heated by hot air from the fan for the engine radiator. The air is thoroughly filtered. The driver's cab is additionally heated by aero-tempers in front of the driver's seat. In this way the car is well ventilated, but to increase this, the platforms and the passenger compartments are equipped with hand operated roof ventilators.

As stand-by, and for extra cold days, an oil burning heater is inserted in the water system.

Figure 10 shows the design of the bogies. They are all welded and equipped with resilient SAB wheels on SKF roller bearings, see figure 11. The axles are held parallel by long swing arms connected to the central bogie frame by rubber-bushes. The spring system consists of involute springs between the swing arms and the bogie-frame. The driving bogie has a differential gear box fitted to its central frame. The gear box is connected to the conical gears mounted directly on the wheel axles by universal driving shafts. The car body rests on rubber pads on side brackets attached to the central bogie frame. The rubber pads permits the car body to make lateral movements and the bogie to turn by passing curves. The traction and braking forces between the bogies and the underframe are transformed by a rubberbushed rod not shown on figure 10. The wheel diameter is 670 mm.

The brakes are electro-pneumatically operated and of a self-adjusted hydraulic type with one block per wheel. The car is further equipped with a mechanical handbrake for parking.

Traction power is supplied by a Swedish direct injected diesel engine, Scania Vabis 815, 8 cylinders supercharged to give 205 HP at 1750 RPM for railway service. The engine is rubber mounted direct to the underframe in one end.

The radiator is situated below the floor and the fan is driven by an auxiliary shaft from the diesel engine.

The transmission consists of a hydraulic coupling Daimler 18", a five speed epicyclic Wilson gearbox R 11 B, a reversing unit, the differential gear box

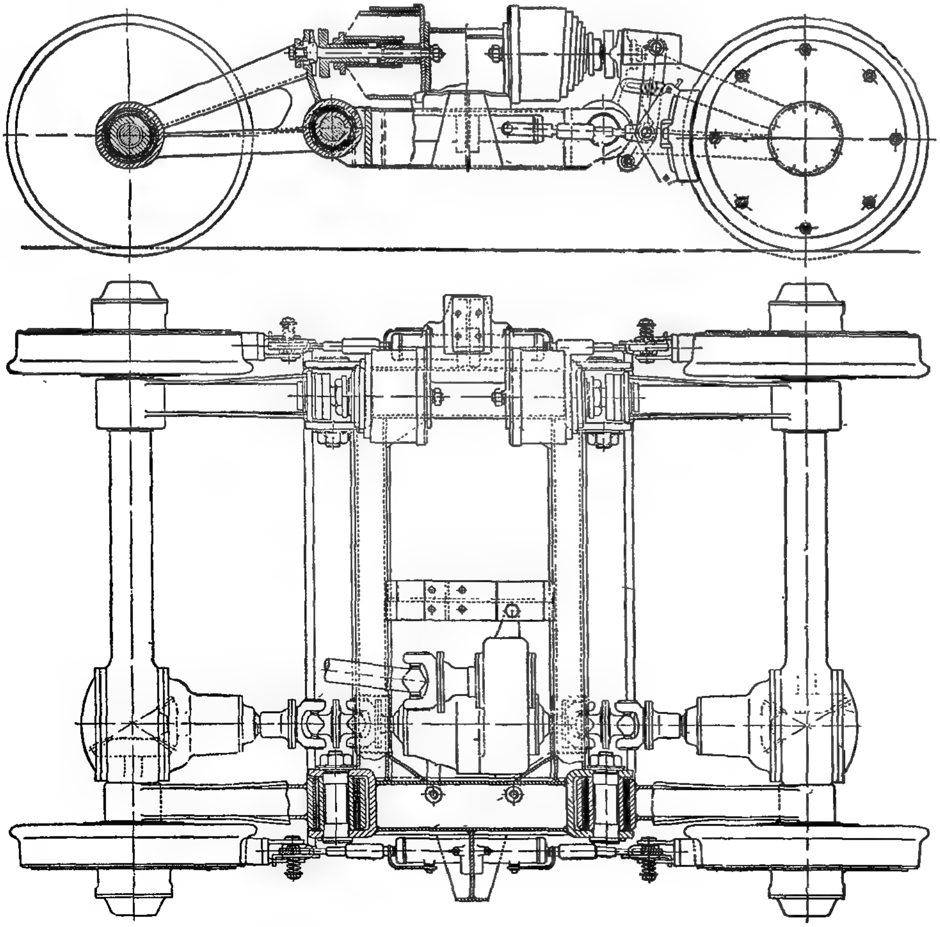

Fig. 10. Principle drawings of driving bogie.

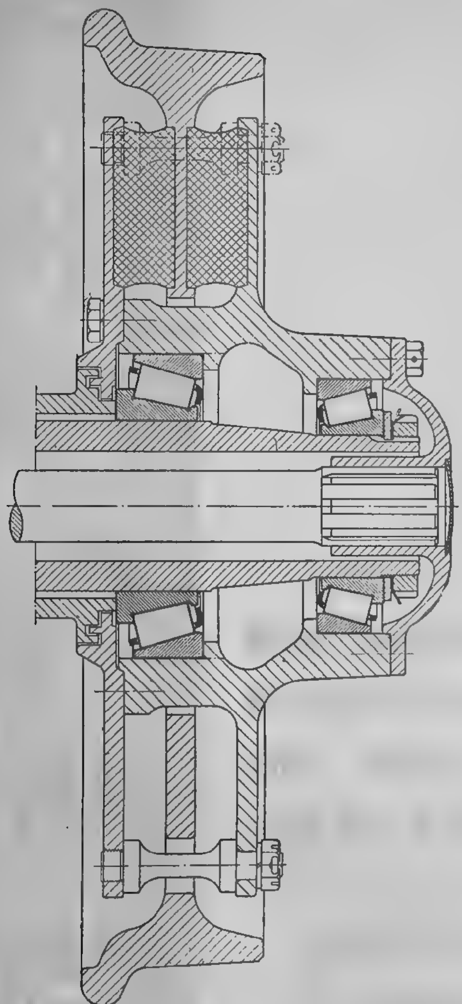

Fig. 11. SAB resilient wheel with SKF roller bearings.

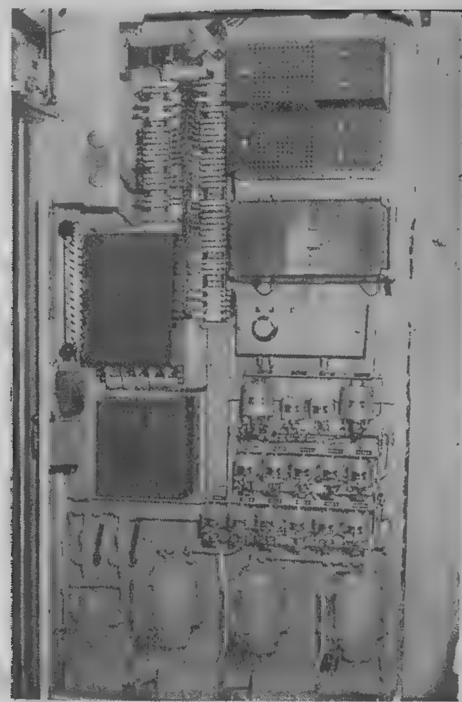

Fig. 12. Apparatus box in driver's cab.

mentioned above and the conical axle gears. See figure 5 and 10. The Wilson gear box and the reversing unit are operated by compressed air by means of E. P.-valves controlled from the driver's stands in both ends.

The air compressor Knorr V 70/155 is beltdriven from the engine. A 24 V 1600 W DC generator and an accumulator battery of 200 amp. hrs. capacity supplies power to the engine starter, lighting and signalling equipment, auxiliary heating fans sirens, sanding, door machines, electropneumatic control system etc. E. P.-valves, relays, switches etc. are easily accessible in the apparatus box in one of the driver's cabs as can be seen from figure 12.

The driver's controls are much simplified. The operations for accelerating, braking, and coasting are carried out by one handle, operating a master-controller of the drum type. The starting of the engine, gear changing, reversing, sanding, and blowing of the sirens can all be done through press-button switches situated on the driver's control-panel, which is further equipped with various indicator lamps and door locking switches. In view of the variations in the traffic intensities during the different hours of the day, the cars are so designed that any number up to 10 can be coupled together through automatic couplers and the whole train can be driven from any one of the very easily operated driver's controls.

The automatic couplers are of Scharfenberg type with built-in pneumatic connections. The car is in both ends provided with hand-operated junction boxes for control current.

The Swedish State Railways have also a great number of trailer cars in the same size as the engine cars, in multiple service generally coupled at a number corresponding to the proportions 3 : 2 or 2 : 1 between engine cars and trailer cars.

These trailer cars are arranged in the same way as the engine car described, i. e. with driver's cabs in both ends, or with half the car adapted to luggage space and with one driver's cab, or, finally, as combined luggage and post cars, without driver's cab.

The same type of cars, but with reduced breadth is used also on the narrow track lines with a track of 0,891 m.

ANNOUNCEMENT

We have pleasure in announcing to all our Readers and Advertisers that we propose to bring out a special Number to our Magazine entitled "EIGHTH ANNIVERSARY TRANSPORT & ENGINEERING" sometime in January 1958.

Editor

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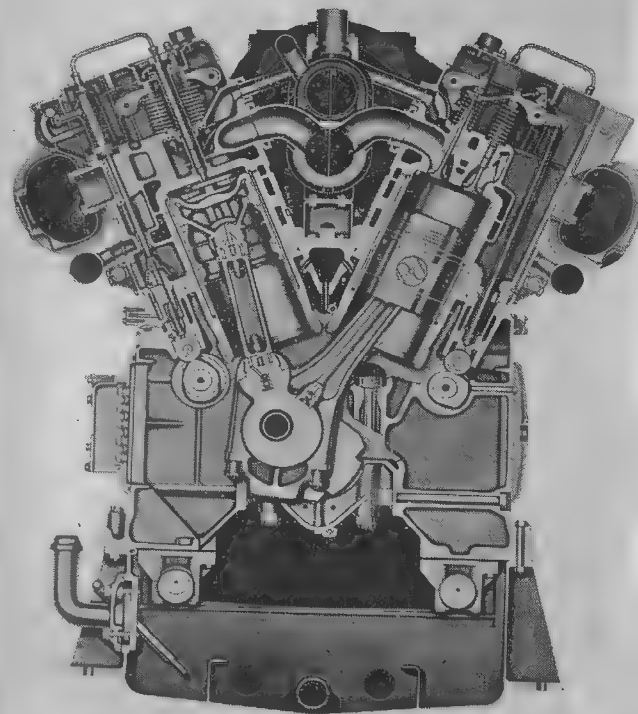
General Electric Locomotives

GENERAL ELECTRIC is marketing a complete line of industrial haulage and road locomotives for the world's railways. Approximately one year ago this company introduced a universal type locomotive that is readily adaptable to varying gauges, braking systems and couplers. By using standard, precision built components which have been tested in millions of miles of railroad service, the world's railways have been furnished with a locomotive that may be used in all types of service—passenger, freight or switching.

A complete line of industrial and mining locomotives is also marketed by this company. Three steel mills in India alone have recently purchased over 38 of these General Electric industrial haulage locomotives. India Iron & Steel Company recently purchased five diesel electric locomotives, two rated at 80 ton, one at 72 tons and two at 31 tons for its plant at Burnpur.

Hindustan Steel Company is currently putting 20 General Electric diesel electric locomotives into service at its new plant in Rourkela.

The third Indian Steel Mill to recently purchase General Electric locomotives was Tata Iron & Steel Company. Two of these are rated at 115 tons and 720 hp. and are the largest size industrial locomotives built by General Electric. Four are 80 ton diesel electrics and one is a 25 ton diesel electric. All the locomotives for the three steel mills are broad (66 inch) gauge and have special equipment allowing them to operate under extremely dusty conditions, heat and humidity that is encountered in the blast furnace area of steel mills. General Electric is also furnishing traction motors, generators, and the diesel electric control systems for 100 ALCO locomotives ordered by India for service on the Eastern Railways.

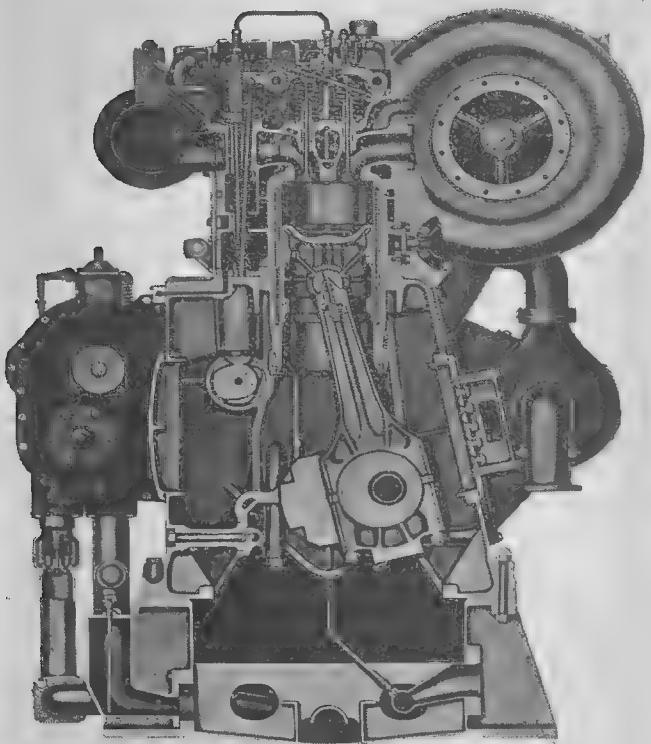


Cut away view of " V" type diesel engine—1320 hp. (8 cylinder) and 1980 hp.

U18C—1980 hp. General Electric Diesel-electric Locomotive.

As part of its standard line of industrial switching locomotives the General Electric Company will furnish customers with locomotives weighing from 25 tons and rating 150 hp. up to locomotives which weigh 88 tons and rate at 1200 hp.

The company has always been well known for its export road locomotives and now is selling a complete line of high horsepower universal-type locomotives. These locomotives use a rugged, 4-cycle diesel engine in six models of the line. All together nine models are available. They range from 990 hp. up to and including 1980 hp. and weigh from 148,500 lb. up to



FW engine used in U9B and U9C Locomotives.

12 cylinder "V" type engine used in U18B and U18C General Electric Locomotives—1980 hp. (165 hp. per cylinder)

211,000 lb. Since the line was introduced in March, 1956, orders have been received from Chile, Mexico, Argentina, and Brazil. According to the manufacturer this new line of locomotives provides superior performance because of the higher horsepower and tractive effort obtainable.

The versatility of the new line is demonstrated in the fact that the locomotives may be used for switching, freight or passenger service. Visability is excellent in both directions and no turning is necessary. Various braking systems and coupler heights may be specified. The universal locomotives may be used on track gauges from 36 to 66 inches. Dynamic braking and train heating equipment may be installed at a small additional cost. World-wide composite clearance diagrams are also met.

In the medium horsepower range four models of locomotives are being sold. These rate at 990 and 1320 hp. and can be equipped with two 2-axle trucks or two 3-axle trucks. All axles are motored with the reliable GE-761 traction motor.

Higher horsepower and axle loading is also provided in the locomotives rating 1980 hp. This is the U18B or the U18C which weighs 211,000 lb. and 203,000 lb. respectively.

All the universal type locomotives are equipped with the General Electric high speed bogie. A floating bolster suspension system is used, which reduces the number of complicated and often inaccessible support members found on most conventional lateral motion trucks. The truck is fully equalized and the weight of the locomotive is distributed through four curved rubber blocks on each bogie. The FV and FW series of engines, which are rated at 165 hp. per cylinder, are used in the heavy duty locomotives. These engines are of a sturdy construction and have been able to achieve their high rating by effectively dissipating engine heat. A unit cylinder with a thin walled, chrome-plated, wet liner is used. This is one of the most advanced developments in the diesel field today. The four cycle engine is easily super charged and a large volume of cooling air is available to the cylinder. Because of valve overlap and the four cycle operation, the cylinder is swept free of the products of combustion and time is allowed for fresh air actually to cool the cylinder.

Effective bearing area on the main bearing is doubled by the use of an articulated connecting rod which is joined to the master connecting rod by means of a special construction that has long been a feature of this FV type engine. The main bearings are interchangeable, precision type aluminum.

Frame and cylinders are made from Meehanite which is a close grained metal bridging the gap between cast iron and tool steel. It combines the high damping capacity, self-lubricating properties and better wear of cast iron with the greater strength, higher resilience and toughness of tool steel.

Agents of the International General Electric Company should be contacted for further information on these locomotives.

More NOHAB-GM locomotives to the Danish State Railways

NYDQVIST & Holm Aktiebolag (NOHAB), Trollhattan, Sweden, delivered on August 16 the first locomotive of the last order from the Danish State Railways.

Earlier NOHAB has delivered 24 locomotives of this type to the Danish State Railways (DSB).

The DSB has made a summary of the expenses for the first four locomotives, delivered by NOHAB in 1954 and they registered savings amounting to £ 35,300:– (Danish Crs. 678,000:–) per locomotive per year in comparison with their steam locomotives.

Some months ago the DSB published a summary of the expenses for the second series of 20 locomotives. In this there is stated that only the fuel savings amount to about half a million Danish Crs. per locomotive per year.

The locomotives are diesel-electric and are manufactured by NOHAB in collaboration with General Motors, U.S.A.

They have two driving axles in each bogie. The bogies are made according to the so called flexi-coil principle with the axles displaceable in the journal

boxes which gives the locomotive an extremely smooth and even running.

The driving machinery consists of one V-shaped 1900 hp. 16-cylinder, 2-cycle diesel engine, manufactured by General Motors, U.S.A.

The power transmission is electric and consists of a generator, direct driven from the diesel engine, regulation equipment, and D. C. motors, which by gears transmit the tractive power to the driving wheels.

The principle technical data are

Max. speed	133 km/h
Max. tractive effort	18 tons
Length over buffers	18,900 mm.
Total wheelbase	14,300 „
Bogie „	4,000 „
Wheel diameter	1,015 „
Weight in working order	106 tons

For heating the train, an automatically working steam generator has been installed.

1800 H.P. Diesel-Electric Locomotives for Indian Railways

Until April 1955, ALCO was known throughout the world as the American Locomotive Company—for more than 100 years a foremost builder of railroad locomotives. During the days of steam locomotives—and since 1948, the diesel-electric unit—the company has built power for nearly every railroad in the world. It has 7,652 diesel locomotives in service today.

The corporate name of the company was changed in 1955 in order to reflect a diversification program that has given ALCO a product line of more than 56 separate items for 11 major markets. All of this, of course, while the company continues to produce diesel locomotives.

Among ALCO's present product line are drilling rig power packages for the oil production industry, diesel engines, special steels (including a new leaded-steel that has been tested and proved), guided missile components, pre-fabricated pipe, rings and forgings, heat exchangers, all types of pressure vessels, atomic power plants and nuclear components.

ALCO operates seven manufacturing plants in this country and is affiliated in Canada with the Montreal Locomotive Works. Domestic plants are at Schenectady, Auburn and Dunkirk, N. Y.; Latrobe, Pa.; Chicago Heights, Ill.; Cincinnati, Ohio and Beaumont, Texas. The company employs approximately 10,000 workers.

ALCO diesel engines through the years have been used in nearly all types of applications where reliable, powerful motive force is required. In addition to powering ALCO diesel-electric locomotives in use by nearly every railroad in the United States and many railroads overseas, they have been adopted also for many stationary and marine applications where dependability is a requisite.

IN March, 1957, the Government of India entered into an agreement with ALCO Products, Inc., of New York, N. Y., U. S. A., for the supply of 100 broad gauge main-line diesel-electric locomotives, having an output of 1800 HP to the generator. The first lot of 20 locomotives will be delivered in India in 1957 and the balance of 80 units will be supplied during the second half of 1958.

ALCO Products, Inc., formerly the American Locomotive Company, is a well known firm of locomotive builders whose first plant was established at Schenectady, N. Y., in 1848. Since that date the company has delivered in excess of 80,000 locomotives to railways of the world. ALCO was one of the diesel-locomotive pioneer companies and its first commercial diesel-electric locomotive was sold in 1925. The diesel-electric locomotives put into service by the firm in the thirty years since elapsed have passed the 8,000 mark, most of which were built since the Second World War, when dieselization began its upswing.

One of the noteworthy features of ALCO's diesel-electric locomotive manufacturing program lies in the thoroughgoing standardization which the company employs. ALCO's ten different types of locomotives make use of three different engine sizes, with outputs of 900, 1800 and 2400 HP. Interchangeable parts are used in all three diesel engines, the difference in output being obtained by varying the number of cylinders. The same braking equipment is available in all units and electrical control components are standardized as well. Only two sizes of traction motors are used to cover the full spread in locomotive size.

In its locomotive roster ALCO differentiates between the heavy domestic type locomotives built for use primarily on U. S. railroads, where the high rail weight enables locomotives to run with axle loadings up to 27.5 tons, and the lighter weight designs intended for use abroad on systems where much lighter rail is employed. The axle loading of the latter units varies from 11 to 18.5 tons.

In addition to being called upon to meet the lower weight limitation of railways outside of the American continent, the company's export units also are built to fit within the international clearance diagram. A further requirement which ALCO has aimed to meet in its design is that the bogie design be conceived to enable satisfactory riding even on track in indifferent or poor condition.

The ALCO "World" locomotive, which is the type ordered by the Indian Government, is ALCO's representative design in the 1800 HP class for use in railways outside of the U. S. A.

DESCRIPTION OF THE LOCOMOTIVE

A view of the first of the locomotives built for India is shown in Figure I, a photograph taken at the builder's works. Buffers and couplers are not shown, as they will be applied in India.

With the minor modifications required by the Indian

Railways gauge, the basic dimensions of the locomotive are as follows:

Height (Roof)		12′ 9-1/2″
Height (Maximum)		13′ 1-3/4″
Width (Over Cab Handrails)		9′ 4″
Length (Over Body)		55′ 7/8″
Length (Overall)		58′ 11″
Weight on Driving Wheels		246,000 Lbs.
Weight on Total Locomotive		246,000 Lbs.
Supplies:	Lubricating Oil Capacity	200 Gallons
	Fuel Oil Capacity	1600 Gallons
	Engine Cooling Water	260 Gallons
	Sand	14 Cu. Ft.

The frame of the locomotive is built of steel sections electrically welded and it consists of a main frame made of two H section beams running the length of the locomotive and two side frames of welded truss construction. The nose of the locomotive is reinforced specially to give additional protection to the engine crew in case of a collision.

The main transverse members of the locomotives carry the bogie pivot castings. The general arrangement of the components is seen in Figure 2, which is the longitudinal cross section of the locomotive.

The major components identifiable in this Figure 2 are the following:

1. Diesel Engine
2. Main Generator
3. Exciter
4. Auxiliary Generator
5. Bogie
6. Electrical Control Compartment
7. Turbosupercharger
8. Oil Bath Type Air Intake Filters
11. Traction Motor Blowers
13. Radiators
14. Radiator Fan
15. Radiator Fan Drive Magnetic Coupling

Fig. 1. One of the ALCO "World" DL-500 locomotives built by ALCO Products, Inc. for the Railway Board of India.

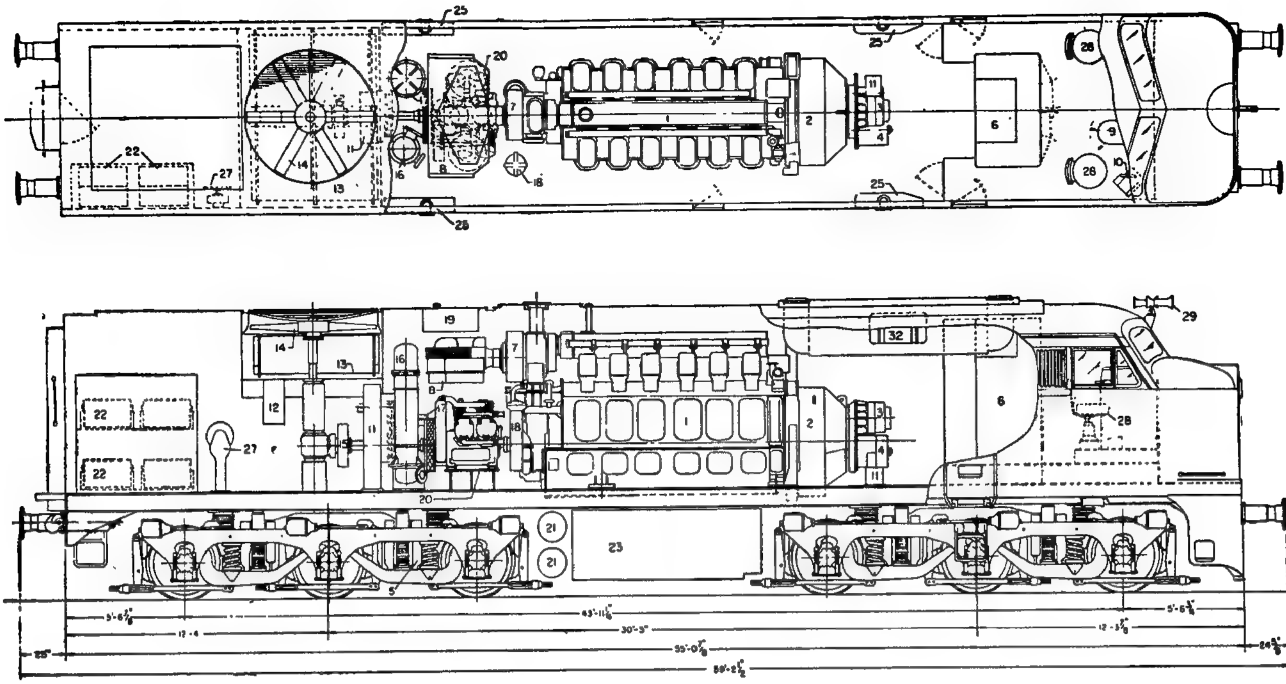


Fig. 2. Cross section of the ALCO DL-500 "World" locomotive.

16. Lubricating Oil Cooler
17. Lubricating Oil Filters
18. Lubricating Oil Strainer
21. Main Reservoirs
22. Batteries
23. Fuel Tanks
32. Dynamic Braking Resistors (applied in some locomotives)

POWER PLANT

The power plant consists of an ALCO Model 251-B 12 cylinder, 4 stroke turbo-supercharged diesel engine of 1950 BHP at 1000 RPM. The engine is described elsewhere and it is of ALCO Products design and construction.

The engine is directly coupled to a General Electric Model GT-581 main generator designed specifically for traction purposes.

This is a 10 pole shunt-wound DC generator with commutation poles. It is a single bearing machine with a gear case at the outboard end from which the exciter, the auxiliary generator, and the traction motor blower for the front bogie motors are driven.

All the air brought into the engine room goes through impingement type panel filters. The air inducted into the engine goes through a bath type oil filter which ensures dust free air and therefore prolongs greatly the life of all the wearing elements of the engine.

The exciter is a GTA AC generator manufactured also by the General Electric Company. The function of this machine is to provide excitation current and excitation control current as well as described later.

Battery charging and other auxiliary loads are operated by a General Electric Model GY 27, 4 pole commutating pole shunt-wound DC generator. The whole assembly of main generator, auxiliary generator, traction motor blower drive and exciter can be removed at once from the engine. This is because it is hung from the engine frame without any independent support on the locomotive. The type of mounting has been traditional with ALCO for a great number of years.

The combination air compressor and vacuum exhauster, and the radiator fan are driven mechanically from the diesel engine. Between the compressor exhauster and the right angle drive gear for the radiator fan, a magnetic coupling has been installed for purposes that will be explained later.

Two of the first twenty locomotives for India will

be equipped with dynamic braking. The resistors are located in their standard position, suspended from the roof of the locomotive ahead of the diesel engine.

RUNNING GEAR

The locomotive wheel arrangement is Co—Co.

The pivot pitch is 30′ 5″ and the rigid wheel base of each bogie 13′ 9″.

The bogies, Figure 3, are of ALCO design, meant especially to provide the best riding qualities on poor or light-weight track. The locomotive weight is carried by large size bogie pins and transmitted to a bogie bolster, which is a cast steel piece H shaped, that sits astride the center motor. This bolster is carried on two sets of leaf springs that rest on special planks suspended by swing links from the cast steel bogie frame. The bogie frame rests by long deflection helical springs on equalizers which transmit the load to the axle boxes. Timken Standard Roller bearings are used, grease-lubricated and the axle box guides are of manganese steel.

Following standard American practices, the traction motors are nose supported and rest on the axles by large bronze bearings lubricated by means of wick type lubricators, single reduction spur gearing is used and the gear ratio is 94 : 17, giving a maximum track speed of 65 miles per hour.

This type of bogie design is typical of high speed American practice, and has been employed in many thousands of main line ALCO diesel electric locomotives built to this date.

Individual brake cylinders are used which apply clasp type brakes using two shoes per wheel.

A 1600 U. S. gallons (1340 Imperial gallons) capacity fuel tank is suspended from the locomotive frame between the two bogies.

BRAKE SYSTEM

The locomotives are equipped with the Westinghouse 6 SLV—1 brake schedule. This provides for straight air brakes for the locomotives and vacuum brakes for the train actuated from a standard 6 SL automatic brake valve on the engine main stand. This brake equipment is also suitable for handling air brake equipped trains by means of very small additions to the equipment applied to the locomotives.

COOLING SYSTEM

Following ALCO standard practice, the diesel engine cooling is done by a means of two large radiators located near the roof in the rear part of the locomotive.

The large radiator fan is driven from the diesel engine through a magnetic coupling, the excitation whereof is regulated by water temperature.

This system, which has been used by ALCO for a great number of years, allows the fan speed to be kept fairly constant throughout momentary fluctuations of engine speed. It does away with the troubles normally associated with direct fan drives while avoiding most of the complications associated with electrically driven fans.

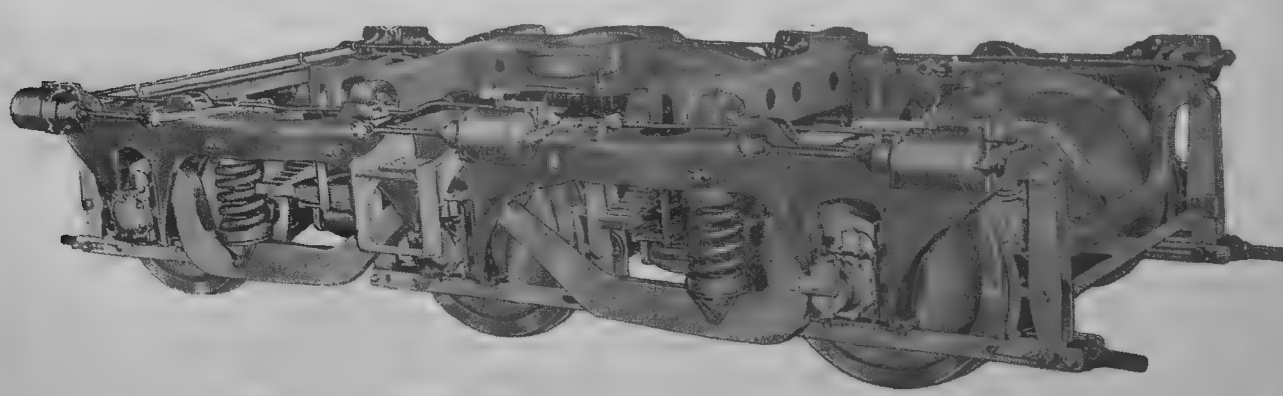


Fig. 3. ALCO-designed bogie, or truck, for the " World " locomotive. These are designed to provide the best riding qualities on poor or light-weight track.

An alarm located in the cooling water system returns the engine idling and lights a warning light on the driver's control stand when the water temperature reaches 195°F.

LUBRICATING OIL SYSTEM

The diesel engine is equipped with a gear type lubricating oil pump driven from the crankshaft with a maximum displacement of 314 U. S. gallons per minute at full engine speed.

The lubricating oil from the engine is forced through a battery of cotton waste packed filters, then through a heat exchanger, where it is cooled by the diesel engine cooling water, and finally through a metallic strainer. After the strainer, it is returned to the engine where it feeds the working parts at pressure as explained in the article covering the diesel engine.

The total capacity of the system is 200 gallons.

FUEL OIL SYSTEM

These locomotives have a capacity of 1600 U. S. gallons of fuel oil (1340 gallons) in a single tank located between the two bogies and suspended from the mail frame.

An electrically driven pump forces fuel oil from this tank through primary and secondary filters and feeds the engine main headers from which the fuel is taken by the individual Bosch type fuel pumps.

Excess fuel oil used to lubricate the moving parts of the pumps and injectors is returned to the main tank by means of drain lines.

CONTROL

The standard control used in ALCO locomotives is installed in these units for India.

The driver controls the operation of the locomotive by two levers located in the engineman's stand.

A throttle lever with eight motor notches and one idle notch regulates engine speed and maximum generator excitation at the same time, thus for each throttle notch, a fixed engine power and fixed horse power are transmitted to the traction motors.

The reverse handle has three positions, forward neutral and reverse and it is suitable interlocked with the throttle to prevent reversing of the motors with power on.

The traction motors are connected across the generator in two major connections, each of which has a shunted field step. The reconnections or transitions are made automatically according to locomotive speed, the action being governed by an axle driven AC generator and a relay panel.

The transitions are two parallel series of three motors, shunted fields, three parallel series of two motors and shunted fields.

A third handle in the engine man's stand provides supervisory control over these connections and, in the case of the locomotives equipped with dynamic braking, controls the excitation of the traction motors which for these purposes are connected as DC generators against a resistor grid.

Traction motor load is indicated by a colored band meter located at the engine man's position. A green band in this meter indicates the loads under which continuous operation without time limit is permissible.

Time limited operation is shown in yellow with numbers indicating the maximum number of minutes for which the load in question can be held.

With the 65 miles per hour gearing used in the locomotives for India, the continuous tractive effort is 45,900 Lbs. at 12 miles per hour corresponding to a factor of adhesion of 18.6%. This means that the full capacity of the locomotives can be utilized for hauling heavy loads at low track speed.

DYNAMIC BRAKING

Some of the locomotives for the Indian Railways are equipped with Dynamic braking, which consists in reconnecting the traction motors across suitable resistors, as separately excited direct current motors. For this purpose, the traction motor fields are connected in series with the main generator. The driver may control the intensity of the braking effort by regulating the excitation. This is achieved by moving the selector handle across the braking range at the controller. By placing this handle as far forward as possible, self-regulating maximum braking effort is obtained at all locomotive speeds, reaching a peak of 37,500 lbs. at 20 mph.

(Continued on page 19)

New Diesel-Electric Locomotives for the Indian Railways

THE order for 100 diesel-electric locomotives of 1800 HP which the Railway Board has placed with ALCO Products, Inc., New York, N. Y., has been reported in the previous article. The first lot of locomotives is to be supplied during the fourth quarter of 1957 and the balance will be shipped to India during the second half of 1958. In recording this order, we should take note that this is a new milestone in the modernization of the Indian Railways which is being vigorously carried out by the Railway Board, as these locomotives will be the first main line diesel-electric units to operate in India.

The need for this new type of power arises from the traffic congestions which are developing on the Southeastern Railway and on the Eastern Railway in connection with the enlargement of existing steel mills and the establishment of three new integrated steel mill plants in Rourkela, Durgapur and Bhilai. Plans are going ahead to electrify the railway divisions which will service these various industrial centers, but until these plans materialize it is intended that the diesel-electric locomotives will fill the gap and meet the mounting traffic pressure. After completion of the electrification, the diesel-electric locomotives will be used to alleviate traffic problems in other congested areas of the sub-continent.

The Southeastern Railway will bear the brunt of the traffic created by the erection of three new steel mills, as the plants at Rourkela and Bhilai are situated on its main route from Howrah to Nagpur. In view of this, it is intended by the Railway Board that 80 of the ALCO units be assigned to that Railway. The third steel plant, located at Durgapur, is on the main line of the Eastern Railway but it also will draw most of its supplies of iron ore and limestone from areas served by the Southeastern Railway. However, the Eastern Railway is meeting constantly rising traffic density on the line to Moghal Sarai and 20 of the ALCO units will be put into service on that section, operating out of Gaya, to assist in speeding up the heavy coal traffic.

The diesel-electric locomotive serves ideally in eliminating traffic congestion due to the outstanding flexibility of the unit. The modern diesel-electric locomotive delivers constant horsepower at all speeds, while the horsepower output of a conventional steam locomotive is quite small at low speeds and rises as the speed increases. As a result, the modern diesel-electric locomotive can haul far heavier trains at the usual operating speeds, or handle the usual trains at higher speeds over the grades that restrict steam operation.

Another favorable characteristic of the diesel-electric locomotive, equally important, is its rapid turn-around time. After delivering a train at a given point of the system, the diesel locomotive is immediately available for coupling to another train and for continuing work twenty-four hours of the day. The steam locomotive, by contrast, will need to take time out at terminals for running maintenance at the running shed and for cleaning of the fires. Also, while enroute, the average steam locomotive is required to stop at intervals of 40 to 50 miles in order to take on fresh water and fuel.

The diesel locomotive does not require watering except for the occasional few gallons which may evaporate from the cooling system of the diesel engine, and its large fuel tank and high efficiency enables it to operate over a distance of 800 to 1,000 miles without taking on new diesel oil. Heavy overhauls on diesel locomotives are likewise performed at longer intervals than for steam locomotives, and the time required to carry out such repairs is greatly reduced.

(Continued from page 18)

This means that a trailing load of 2050 tonnes may be brought down a one in 100 grade by one of these locomotives, at 20 mph, without requiring the use of vacuum or air brakes to hold the speed constant.

This feature is used by a majority of the locomotives that must operate in territories with severe grades. It results in longer wheel life, a decreased consumption of brake shoes, and a greater safety in operation. The smooth handling of the train provided by dynamic brake results also in less damage to the goods carried.

All these properties make the diesel locomotive available for actual transport use over a far greater period than the steam locomotive. Experience has shown that the availability of the diesel locomotive can easily be maintained at 90%, while a considerable effort is required to achieve 50% with steam locomotives. The greater availability enables the diesel locomotive to average over 10,000 miles per month hauling trains, while the average for steam locomotives in India currently is around 3,000 miles per month. It is generally found that a modern main line diesel-electric locomotive will perform the same work as 2 or 2.5 steam locomotives.

The high overall efficiency of the diesel locomotive makes it an economic unit to operate. A modern unit, such as the ALCO locomotive purchased by the Railway Board, will easily attain an efficiency of 28% measured at the wheel rims, as against an average efficiency of 5% maximum for steam locomotives. The advantage in fuel economy of the diesel-electric locomotive may not be a significant factor on railways serving the coal fields, as Indian coal is favorably priced. However, freight rates on coal have risen considerably in recent years and the diesel locomotive will show a distinct savings in fuel costs in areas away from the coal fields, such as in central and southern India. Other substantial savings are found in the lower maintenance cost of the diesel-electric locomotive. These savings in repair costs are due primarily to the absence of steam locomotive boiler repairs.

The collaboration agreement which the Railway Board has entered into with ALCO Products, Inc., also covers for the training of railway personnel on the part of ALCO, and engineering assistance in the design and layout of maintenance facilities. The study of the latter facilities, in cooperation with the manufacturer's engineers, has already been completed and running repair sheds are under construction at Gaya on the Eastern Railway and at Anara on the Southeastern Railway. Some items of maintenance equipment are being imported from the U. S. A.

For the advance training of personnel, the Eastern and the Southeastern Railways have each sent a group of eight men to the U. S. A. for training at builder's plant and for observation of maintenance practices on some of the U. S. railways. The manufacturer operates a special Locomotive School in which crews from all over the world are given courses on the maintenance and operation of the ALCO locomotive. Training periods in the U. S. A. last about three to four months. Other groups will follow the first two sent to the U. S. A. and it is expected that a total of about forty men will have been trained by the time the 100 locomotives are in service.

Training in the U. S. A. is supplemented by instruction imparted in India by ALCO engineers sent out for the purpose and by Railway engineers previously trained in the U. S. A. The manufacturer will send three experienced engineers to India for the instruction of Railway personnel.

The diesel-electric locomotive has been subject to intense development and considerable improvement over the past ten years, notably in the U. S. A., so that it represents a highly reliable machine in its modern form. The high operating efficiency and excellent reliability have combined to make the diesel-electric locomotive a strong economic factor in the modernization of railways around the world.

In the U. S. A. over 90% of all steam locomotives have been replaced by diesel-electric units. Dieselization has progressed in other countries, although at a slower rate. It is not likely that full dieselization will ever be contemplated in India where coal is abundant. However, the Railway Board has decided to embark upon a course of partial dieselization in order to benefit of the advantages of this type power in areas where the Indian Railway system will profit most.

FACTORY TO BE SET UP AT SALEM

Some tentative proposals for extending technical collaboration and the broad terms of deferred payment which were under further negotiations, had been received from a French firm of non-ferrous metals manufacturers to establish an aluminium project at Mettur in Salem, Madras State, said the Union Minister of Industry, Mr. Manubhai Shah, in the Lok Sabha on December 14. Asked by Mr. Raghunath Singh as to the estimated cost of the project and the anticipated output, the Minister said it might be about Rs. 12 crores and the production would be of the order of 10,000 tons of aluminium per annum. Mr. Shah told Mr. Ramanathan Chettiar that a firm in the U. S. A. had also made an offer to put up a plant. The Minister stated in reply to another supplementary that the annual requirements of aluminium in the country were 40,000 tons and the present production was about 12,500 tons.

The S.N.C.F. (French Railways) will help to equip the Indian Railroads

BEFORE leaving for India after a two and a half months stay in Europe, Mr. Karnail Singh, one of the principal directors of the Indian railways, met Mr. Louis Armand, president of the S. N. C. F., and talked about extending the recent agreement on large scale technical assistance by the S. N. C. F. in electrifying with a single-phase system (25,000 volts, 50 cycles) 1,000 kilometres of main line in the Calcutta region.

The S. N. C. F. is being helped by the Sofrerail Engineering Company, which was created and is presided over by Mr. Armand Porchez, for the spreading French railroad technique abroad.

The electrification of the suburban lines around Calcutta, and then, during the Second Indian Plan, of the 2,000 kilometres of main line around Madras and Bombay, can be done with the same technique. In addition, India has ordered 50 electric locomotives from a group of European builders, including Belgian, Swiss and French. Forty percent of this order, amounting to a total of 4 milliard francs, will be done by French builders.

Mr. Karnail Singh said, about the agreement which was just reached, "It is much more than a simple technical agreement. French engineers have acted as pioneers in the use of alternating current, it is true, but the collaboration established must be infused with the French railwayman's spirit which has produced such noteworthy results, particularly under the direction of Mr. Louis Armand".

"The French engineers who have gone to India have already prepared this cooperation. It is only one aspect among many others, of the rewarding agreements between the French and Indian governments".

* * *

HIGH VOLTAGE A. C. TRACTION FOR RAILWAYS

Mr. M. N. Chakravarti, General Manager of the Central Railway, Bombay said that a high-level team of engineers, led by a technical member of the Railway Board, which visited France and other European countries recently had come to the conclusion that electric traction on the 25,000 volts alternating single phase current would be eminently suitable for India.

Mr. Chakravarti said the system was working faultlessly on railways in France and the Government had accepted the recommendations of the team of experts and had decided to increase the mileage for electrification under the second five-year plan from 816 to about 1,300, raising the cost to about Rs. 111 crores.

The General Manager of the Central Railway was presiding over a photographic exhibition and screening of films highlighting the achievements of the French railways held by the French Trade Commissioner in Bombay.

Discussing the future of electric traction in India, Mr. Chakravarti said in the field of modern motive power on the heavy traffic lines in India, the choice fell more on electric than on diesel traction. The advantage of electric power was the great potential India possessed for generating hydro-electric power at low cost. The main disadvantages of diesel power was that it made vital sections of the railway almost solely dependent on imported fuel for operation. It was for this reason that sections carrying the heaviest volume of traffic would have to be operated by electric traction, he said.

Mr. Chakravarti said the French Government had readily agreed to assist India in regard to electrification of sections of the railways and some French experts were already in the country. A three-member French team led by Mr. Nouvion came to India last year entirely at the cost of the French Government to advise the Indian Railways, he said.

In the post-war period, Mr. Chakravarti said, 3000 volts D. C. had been initially adopted as the standard as it was more economical than the 1,500 volts D. C. system at present in vogue in Madras and Bombay regions. In the meanwhile, high voltage single phase alternating current traction was developed and its economies both in respect of first cost as well as in respect of maintenance and operation costs established its superiority over the 3,000 volts D. C. system.

General Manager's Press Conference

STEPS TAKEN TO MEET INCREASED TRAFFIC AND REDUCE OVERCROWDING

SHRI M. GANAPATI, General Manager, Western Railway, addressing a Press Conference in the Board Room at the General Offices, Churchgate, Bombay, announced the measures adopted to clear the increased traffic and reduce overcrowding. He stated that important Mail and Express trains on the Broad Gauge have been already strengthened within the maximum permissible load and important trains on the Metre Gauge were also being strengthened.

The possibility of increasing the maximum permissible load, reducing the speed if necessary, to clear a large number of passengers was also being examined.

On the Metre Gauge, the partially air-conditioned coach on the Ahmedabad-Delhi Express which was introduced in July 1957, was withdrawn and replaced by a third class coach. The Dining Car on the Ahmedabad-Delhi Express was being withdrawn and replaced by third class accommodation.

On the Broad Gauge, the Dining Car running on the Flying Ranee between Bombay Central and Surat was being replaced by third class accommodation.

Referring to the Railway's Plan for increased movement during the First Five-Year Plan, Shri Ganapati revealed that during 1955—56, the last year of the First Five-Year Plan, a total of 11.40 million tons of originating goods traffic was lifted and at the end of the Second Five-Year Plan this traffic is expected to increase to the order of 18.80 million tons. The average daily wagon loading as well as loading at transhipment points during 1956—57 as compared to the previous year, had also shown an increase. Similarly a 15% increase in passenger traffic is being planned for. In 1955—56, 305 million passengers were carried and at the end of the Second Plan period about 350 million passengers are expected to be carried on this Railway.

The General Manager stated that during the first year of the Second Plan as compared to the previous year, gross traffic receipts had increased from Rs. 50.24 crores in 1955—56 to Rs. 55.30 crores in 1956—57, thus indicating a substantial increase of Rs. 5.06 crores in 1956—57.

While pointing out the important features of the new Time Table to come into force from 1st October 1957, the General Manager said that trains would be speeded up in the Saurashtra area.

Referring to the Bombay Suburban Section, he said that the number of trains had been progressively increased from 301 in October 1955 to 333 in June 1957 and will be increased to 347 from 1st October 1957. He also stated that punctuality of suburban trains was well over 90%.

With regard to compensation claims on the Western Railway, Shri Ganapati expressed satisfaction that during the year 1956—57, the number of outstanding claims at the end of the year was 6745 as against 6,958 at the commencement of the year. Regarding disposal of claims, the average time taken was 45 days. This figure has subsequently been improved and the present average time taken for settlement of a claim is about 40 days.

With regard to the construction of new lines, Shri Ganapati said that the 26.93 mile Fatehpur Shekhawati-Churu line had been opened for all descriptions of traffic from July 1, 1957. The estimated cost of this project was Rs. 64.92 lakhs.

The 49.23 mile Indore-Dewas-Ujjain Line would be ready to be opened for all descriptions of traffic by the end of the Calendar year. The estimated cost of this project would be Rs. 290.35 lakhs. The 43.6 mile Bhildi-Raniwara line undertaken at an estimated cost of Rs 119.45 lakhs, is also to be opened by the end of the Calendar year.

The metre gauge link between Gandhidham and New Kandla was opened for all descriptions of traffic on October 1, 1956 with a temporary station building. The length of this line was 7.51 miles and the estimated

cost Rs. 81.52 lakhs. A new station was being provided.

Referring to the projects of doubling the lines, Shri Ganapati pointed out that the work of doubling of the line between Godhra and Ratlam (116 miles) was expected to be completed by about the end of 1958. The estimated cost of this project was Rs. 850 lakhs. The doubling of Baroda-Anand line (20 miles) costing Rs. 99.71 lakhs, has been sanctioned and the work had started. It would take two years for completion. The Nagda-Ratlam (25.50 miles) section was also proposed to be doubled at an estimated cost of Rs. 210 lakhs.

Remodelling of Marshalling Yards had also been undertaken. The project of remodelling the Sabarmati Yard at an estimated cost of Rs. 157 lakhs was almost complete. A scheme for the remodelling of the Metre Gauge Yard at Ahmedabad at an estimated cost of Rs. 1.7 crores had been sanctioned and the work was expected to be taken in hand shortly.

During the Second Plan period improved goods facilities were planned at 19 stations on the Broad Gauge and 40 stations on the Metre Gauge at a cost of Rs. 106 lakhs.

During the Second Plan work in connection with the expansion facilities in workshops is expected to cost Rs. 572 lakhs. A new wagon Repair Shop at Kotah and Carriage Repair Shop at Rajkot are being provided. The existing Locomotive and Carriage and Wagon Shops at Ajmer, the Loco Shop at Dohad and the workshops at Jaipur, Mahalaxmi and Parel are being remodelled.

Apart from the improvements in the mechanical shops, a new signal shop was being provided at Sabarmati for the manufacture of signalling and interlocking equipment.

A Civil Engineering Workshop was also under construction at Sabarmati for dealing with fabrication of steel work, manufacture of Points and Crossings, manufacture of Concrete Products, repairs of engineering plant and machinery.

An amount of Rs. 250 lakhs had been earmarked for the provision of amenities to staff out of which a major portion would be spent on the provision of medical facilities. A substantial amount of Rs. 6 crores had been earmarked for the provision of quarters which were being provided to staff on the line to the maximum extent possible. An amount of Rs. 300 lakhs had been earmarked as provision in the Plan for increased amenities to passengers.

INDIAN RAILWAY FOREMAN LEARNS BRITISH TECHNIQUES

STUDY COURSE UNDER COLOMBO PLAN

Various aspects of the construction and maintenance of rolling stock are being studied by Mr. Anil Kumar Ghosal, engineering foreman with Western Railway in India, who is now in the United Kingdom as an advanced trainee under the Technical Co-operation Scheme of the Colombo Plan.

In the first six weeks since he arrived in Britain at the end of September, Mr. Ghosal has been studying design work with the Metropolitan-Cammell Carriage & Wagon Co. Ltd. at Birmingham.

" I have already seen a lot and learned a lot ", Mr. Ghosal said in an interview. " Rolling stock in the future in India, both imported and indigenous, will be of modern design, necessitating a thorough knowledge of construction, repair and maintenance. It is, therefore, most valuable to me to come to Britain to study new techniques on the spot. I can only say again that the experience I am gaining wherever I go is extremely valuable ".

From Birmingham Mr. Ghosal has now moved to Luton, Bedfordshire, where he is attached to the Skefko Ball Bearing Co. Ltd. There he is studying rolling contact bearings and also lubricants.

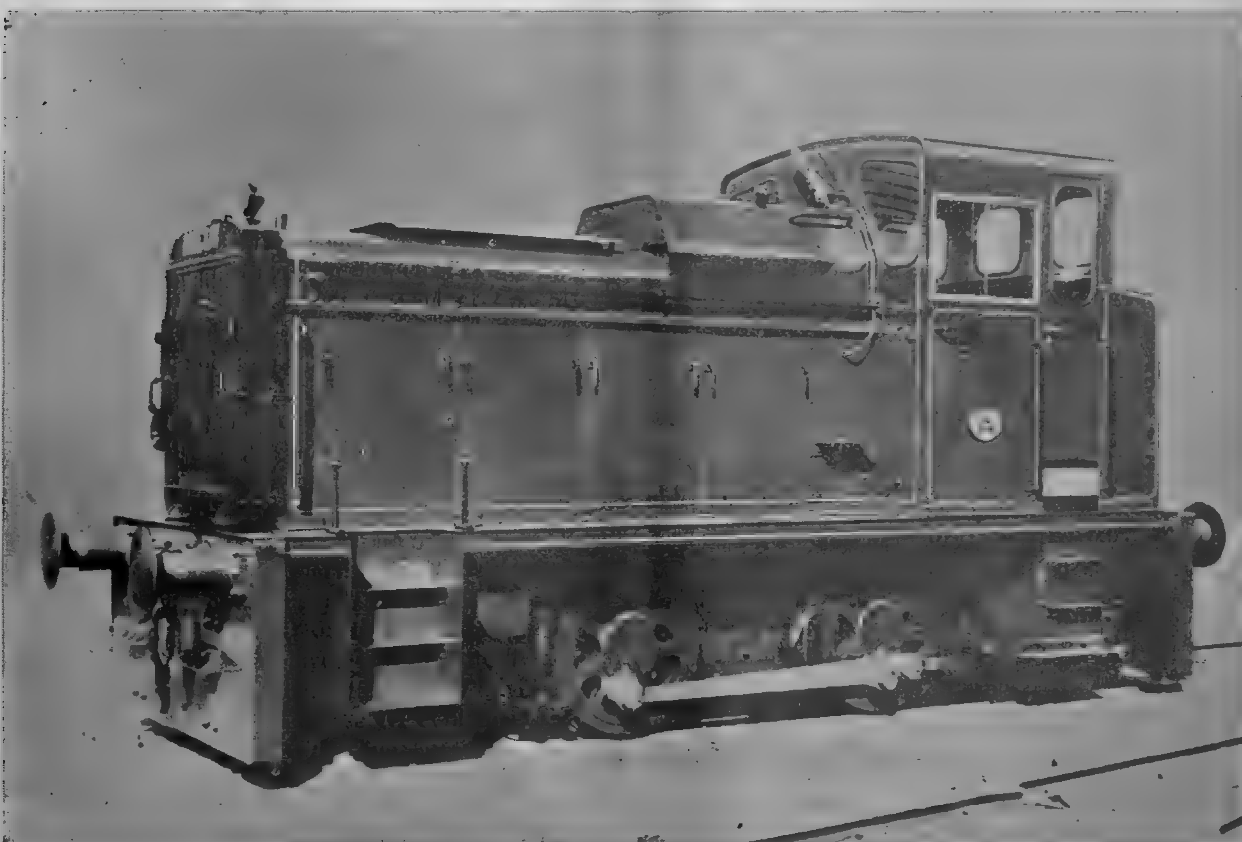
After finishing the Luton section of his Colombo Plan course, Mr. Ghosal goes on to the Estleigh Carriage and Wagon Works and will spend three months in this Hampshire construction and maintenance section of British Railways' southern region.

A New Diesel Hydraulic Locomotive

THE diesel hydraulic locomotive is now well established and several types are in operation using hydraulic torque converters of various designs. A new type, the principal feature of which is its simplicity, has been introduced by Messrs. Andrew Barclay, Sons & Co. Ltd., of Kilmarnock, for whom, Parry & Co. Ltd. are Agents in India. This locomotive is fitted up with a British Twin Disc torque converter, the first to be applied to a locomotive in this country.

The locomotive is of the 0–4–0 type and is fitted with a National five cylinder diesel engine developing a maximum of 200 B. H. P. at 1500 r. p. m. The locomotive is intended for shunting duties and for this class of work, the most desirable characteristic is a high tractive effort for starting combined with a steady pull to minimise wheel slip and with the possibility of accelerating steadily up to a moderate speed.

Most diesel hydraulic transmissions have hither to embodied two or more converters or a converter and fluid coupling or a converter and change speed gearbox in order to provide a sufficient range of torque variation but the British Twin Disc three-stage torque converter is capable of giving a maximum range of 5 or 6 to 1 and can therefore be used as a single unit in a shunting locomotive. The operation of the converter is entirely automatic, depending on the speeds of the input and output shafts. Actually the full range of 5 or 6 to 1 torque multiplication is not used as the efficiency is low when the multiplication is as high as this but part of the range is used giving a torque multiplication of approximately 4 to 1. This is equivalent to that obtainable from a normal 4-speed gearbox. This wide range is not obtained from any serious loss of efficiency, the efficiency of the converter being 70% at each end of this range and at its best speed the efficiency rises to a maximum of 82%. It will be observed that the tractive effort is perfectly smooth there being no breaks or steps in it such as in the graph of a change speed gear box. It is thus possible to fit the tractive effort of the locomotive exactly to that called for by the load and to utilise the full power of the engine at all times. This is not always possible with a change speed



gearbox as the tractive effort required by the conditions may not be exactly obtainable without adopting a lower gear and running the locomotive at a lower speed than might otherwise be obtainable. The smooth variation in the tractive effort of a hydraulic locomotive ensures that there is no jerking of the transmission or train such as occurs when changing gear on a diesel mechanical locomotive. This is of particular importance when working with loose coupled rolling stock. Compared with a two or three stage hydraulic transmission, there is no governor or arrangement of valves to control the change-over from one stage to the other. In addition to this, there is no free wheel.

The application of power when starting from rest is perfectly smooth and the locomotive can therefore be of the minimum weight to give the maximum tractive effort. The maximum tractive effort of this locomotive is 20,000 lbs. It is 18,000 lbs. at 2.4 m.p.h. and 4,500 lbs. at 9.6 m.p.h., this being the range of speed in which the efficiency of the converter is 70% or over. The weight of the locomotive is 31 tons giving an adhesion ratio of 3.5 to 1 with the 20,000 lbs. tractive effort. The locomotive will run up to a maximum speed of 11 m.p.h.

The engine is of the National M4AA5 type having five cylinders 6″ bore by 8½″ stroke. It is set to develop a maximum of 200 B.H.P. at 1500 r.p.m. this being a 12-hour rating. It is of advance design and incorporates four-valve cylinder heads with controlled turbulence resulting in high thermal efficiency with good combustion at all loads. Solid injection into an open combustion chamber is used. Starting is by electric motor engaging with a toothed ring on the flywheel.

Electric lighting is provided on the locomotive consisting of head and tail lamps, a cab lamp, a lamp under the engine casing, two lamps over the instrument panel and a portable inspection lamp. These are supplied from the starting batteries which are of ample capacity.

The mechanical construction of the locomotive is extremely simple. The Twin Disc torque converter is rigidly mounted on the engine crankcase, in addition to which it is supported at the output end from one of the locomotive frame stays. From the output shaft of the torque converter the drive is taken by a propeller shaft with Layrub flexible couplings at each end and the drive is taken from these to the rail wheels by means of connecting and coupling rods. The reverse gear is of the bevel type consisting of a bevel pinion running between two crown wheels which are mounted on roller bearings on a cross shaft. Either of these crown wheels can be connected to the cross shaft by means of a multiple toothed clutch which slides between them on splines on the shaft. From this cross shaft the drive is taken by means of double reduction spur gears to the jackshaft. All shafts in the reverse and final drive unit including the jackshaft are mounted on roller bearings. The casing of the gearbox is of cast iron and is bolted to the frame by fitted bolts so that in addition to forming a rigid mounting for the jackshaft, it acts as an effective frame stay. It is possible to dismantle the gearbox and remove all shafts including the jackshaft without disconnecting the principal casting from the frames of the locomotive.

A friction clutch is embodied in the torque converter casing between the engine and the torque converter. This clutch is only fitted to provide a free engine when the locomotive is standing and to facilitate operation of the reverse gear. It is of the over-centre type and is therefore either fully engaged or disengaged. It is not used for taking up a load and the wear on it is consequently negligible. It must be engaged to connect the engine to the torque converter and must be disengaged momentarily to eliminate the drag torque of the converter to allow the reverse gear clutch to be moved. It is operated by a hand lever and requires very little effort. An interlock of a simple mechanical type is provided to prevent the reverse gear handle being moved unless the clutch is disengaged.

Another interlock, patented by Messrs. Barclay, is also provided to prevent the reverse gear handle being moved unless the locomotive is stationary. This is operated by the flow of oil circulating in the final drive gearbox. So long as the locomotive is moving, and consequently the coil is circulating, a plunger is held up to intercept a sector on the reversing handle shaft, so that it cannot be moved. When the locomotive stops and the oil flow ceases, this plunger recedes and the reverse gear handle can be moved, provided at the same time the clutch is disengaged.

The frames are exceptionally rigid being 1½″ thick and are built up with frame stays bolted to them with turned driven bolts. The engine and torque converter are mounted on a rigid sub-frame. The buffer beams are steel 6″ thick to provide the necessary weight for adhesion. The ballast weight is thus in its most effective position for absorbing shunting shocks. The locomotive was built for 4′—8½″ gauge with a wheelbase of 6 ft. The wheels are 3′—2″ diameter. A sectional radiator of Messrs. Reliance Manufacturing Company's make is fitted at the front of the locomotive

and contains separate sections for engine cooling water and lubricating oil. An auxiliary radiator is fitted in front of this to cool the fluid from the Twin Disc torque converter. A sheet steel casing is fitted over the engine with provision for ventilation at the top. A large fuel tank of 275 gallons capacity is fitted at the top of the casing, close to the cab so that it does not obstruct the driver's view. This fuel supply should be sufficient to keep the locomotive running for about four weeks if working on day shift work only. The cab is of welded construction with large windows giving the driver an excellent view all round. The side windows are of Beclawat type arrange to slide to open. The doors are divided, the top half, which is glazed, being arranged to open independently of the bottom half.

The driving controls consisting of throttle lever, clutch, brake lever and sanding levers are duplicated so that they can be operated from either side of the cab. The throttle, brake and reversing handle are conveniently grouped on a desk in front of the driver. An adjustable seat is provided for the driver at each side of the cab. A Clayton S12 type heater is fitted in the cab. It is operated from the engine cooling water system and the warm air is circulated by an electric fan.

The brakes are of the Westinghouse compressed air type, supplied from air compressors driven by Vee-belt from an extension shaft at the front of the engine. This extension shaft is drive through a flexible coupling and it carries also a pulley for the Vee-belt drive to the radiator fan. The compressed air for the brake system is also used to operate the reverse gear by means of diaphragm cylinders.

A gauge and instrument panel is fitted above the driver's desk and carries the following instruments.

Westinghouse Duplex air pressure gauge, gearbox air pressure gauge engine oil pressure gauge, gearbox oil pressure gauge, converter oil pressure gauge, engine oil temperature gauge, water temperature gauge, converter oil temperature gauge, tachometer, speedometer with mileage recorder, ammeter, lighting switches and starting button. A lock-type switch is also provided to prevent unauthorised starting of the engine. A fuel gauge is fitted in the end of the fuel tank and is visible above the instrument panel. A warning light is also fitted on the instrument panel to indicate when the temperature of the fluid in the torque converter is approaching the high limit.

The driving of the locomotive is simplicity itself. To start, after the engine is running, it is only necessary to engage the clutch and gradually ion the throttle. The engine will speed up and the torque converter will take up the load and it will start with perfect smoothness. If the throttle is fully opened, the speed will rise to the maximum which the power of the engine and the weight of the train will permit and the locomotive will run at this speed indefinitely without overheating of the torque converter, provided the load is within the maximum capacity of the locomotive. It should be noted that it is impossible to stall the engine by overloading the locomotive or by mishandling. The only controls which the driver needs to operate are the throttle, brake, reversign handle and clutch. As in all diesel locomotives, except the diesel electric type, it is necessary to bring the locomotives to a standstill before the reverse gear is changed. As explained above, a patented interlock is fitted to ensure that this is done.

It has been the aim of Andrew Barclay, Sons & Co. Ltd., to produce the simplest possible form of diesel shunting locomotive, both in construction and handling. This aim has been very successfully accomplished in this prototype locomotive, which has already undergone successful tests. It is the forerunner of a range of similar locomotives with powers up to 400 H. P. and the Company has already received orders for locomotives of 302 H. P. with British Twin Disc torque converters.

MANGANESE ORE

It is reported that shortage of railway wagons at some mine heads have seriously affected the export trade in Indian manganese ore in recent times. According to this report, the Madhya Pradesh Mineral Industry Association has, in a memorandum to the Union Minister for Commerce and Industry pointed out that unless immediate arrangements for wagons are made, the members of the Association may not be able to transport all the quota before the date of expiry i.e. June 30, 1958. The Association is further reported to have represented to the Government that "out of about 10.85 lakh tons of manganese ore for export registered with the Eastern Railway authorities the quota of State Trading Corporation alone amounts to 6 lakh tons".

Total imports of manganese ore in France during the month of August last totalled 67,999.6 tons compared with 54,237.8 tons in the preceding month out of which imports from India totalled 25,406.6 tons against 28,238.3 tons in the preceding month.

PRESS CONFERENCE AT SECUNDERABAD BY THE GENERAL MANAGER, CENTRAL RAILWAY

AT a press conference held in Secunderabad Shri M. N. Chakravarti, General Manager of the Central Railway, reviewed the working of the Secunderabad Division. An analysis had been drawn up covering generally the period from 1951–52, the first year of the First Five-Year Plan, to 1956–57, the first year of the Second Plan, and a copy of this analysis covering the salient aspects of this Division's working was handed over to the pressmen.

Furnishing statistics of passengers, Shri Chakravarti stated that train occupancy in the last pre-war year 1938–39 showed that an average of 162 passengers travelled per train on the ex-N. S. Railway whilst on the ex-G. I. P. Railway main line section and the Bombay Suburban electrified section the corresponding figures were lower at 146 and 111. The occupation had risen appreciably since then in spite of more trains being added and more coaches being put on per train. The traffic offering had outstripped the capacity and this led to overcrowding. Nevertheless, between 1951–52, the first year of the First Five-Year Plan and 1956–57 the first year of the Second Five-Year Plan, the overcrowding had eased, he explained, for the occupancy per train, taking 100 as base for the year 1951–52 had dropped to 94 on the main line section of the Central Railway as a whole and to 88 on the Secunderabad Division. This had been the result of progressive addition to the passenger train services on this Division which had raised the passenger train miles by 15.5%. He also announced the several improvements in the passenger services on the Secunderabad Division including an extra express train which have since come into effect from October 1, 1957.

Referring to movement of goods traffic over the Secunderabad Division, Shri Chakravarti stated that this had gone up by 52.9% in the year 1956–57 when compared with 1951–52 as measured by the freight ton miles carried which rose from 684 millions to 1,056 millions. The increase in the number of wagons during the same period for moving this traffic was 32.8%.

Continuing his address the General Manager stated that the result of the sustained efforts made during the last few years had been remarkable as reflected in the steady decline in the goods on ground registered at stations for which wagons were indented. This figure of go ds on ground represented the arrears of traffic to be moved. On the broad gauge there were 5,438 wagon-loads of goods traffic on ground on September 1, 1955 and on September 1, 1957, there was less than one-tenth of this traffic on ground, the actual figure being 510 wagon-loads which represented just two days' loadings. On the metre gauge there were 2,699 wagon-loads of goods traffic on ground on September 1, 1955 and on September 1, 1957 there were just 97 wagon-loads which was less than half a day's loading. Wagons were now idling on the metre gauge for want of traffic and an appeal had been made to the trading public to come forward and move their traffic now while the wagon position was so easy.

Speaking of efficiency in the usage of wagons and engines, Shri Chakravarti stated that effectiveness of steps taken could be gauged from the recognised user indices for measuring operational efficiency. The extent of wagon usage as assessed by the wagon miles moved per wagon day and the net ton miles carried per wagon day showed increases on the broad gauge of 12.2% and 24.5% but on the metre gauge there had been a decline of 11.2% and 4.4% respectively. Engine usage, which was rated on the number of engine hours per day per goods engine in use and on the net ton miles carried per goods locomotive day in use, showed increases on both the broad and the metre gauges ranging from 6.1% to 24.5%.

Referring to the creation of additional transport capacity under the Second Plan, he said that even more of a problem than putting into service of extra wagons, engines and coaches would be the creation of additional line capacity to enable new trains being run. This was particularly important as some sections of the line had already reached saturation capacity, Shri Chakravarti stated.

Among the more important of such works to be undertaken on the Secunderabad Division to increase line capacity would be the remodelling of 12 yards, some of which were already heavily congested, the construction of additional loop lines at 24 stations and the building of 24 new crossing stations.

The Mechanical Workshops at Lallaguda would be expanded. The Signal Workshops at Mettuguda were also to be expanded and modernised so that a lot of signalling equipment at present being imported would be manufactured locally. An All-India Signal and Telecommunication School was shortly to be opened at Secunderabad where staff of All Indian Railways would be trained. Secunderabad itself might be provided with modern colour light signalling, whilst Multiple Aspect Upper Quadrant Signalling would be introduced over the whole of the Grand Trunk route from Balharshah to Bezwada so as to speed up the movement of trains on this Section. There would also be several works to expand and improve the facilities at Goods Sheds, Parcel Offices and Tranship Sheds More and better amenities would be provided for passengers particularly where these were at present either wanting or were sub-standard.

Staff welfare, too would be looked after to the maximum extent possible, Shri Chakravarti said, within the resources available.

A Nailable Floor with a Backbone of Steel

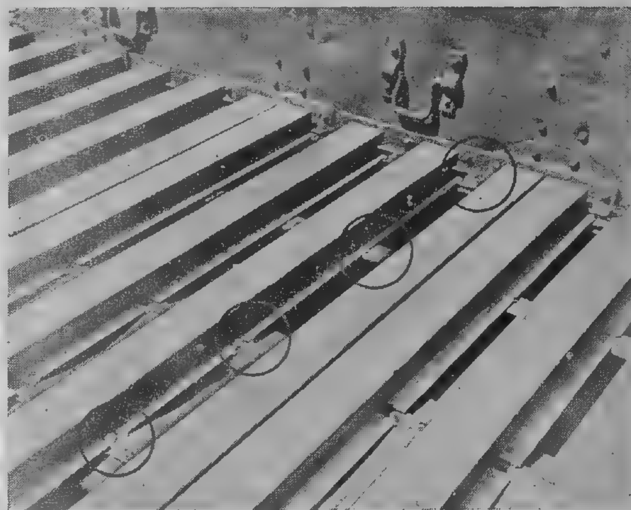
By W. E. McFee,
Supervisor, Product Information Service, Armco Steel Corporation, Middletown, Ohio

ARMCO freight car floor is a composite steel and wood flooring for gondola, box and flat cars. It is designed both for new construction and for replacement of worn-out wood or steel-plate floors in existing cars. The Armco floor consists of formed steel ribs and wood planks laid alternately. The steel ribs are hat-sections and their top surfaces form part of the floor. The heavy wood planks are nailing strips. They are supported by the flanges of the steel ribs and are fastened with bolts. The ribs themselves are welded to the underframe.

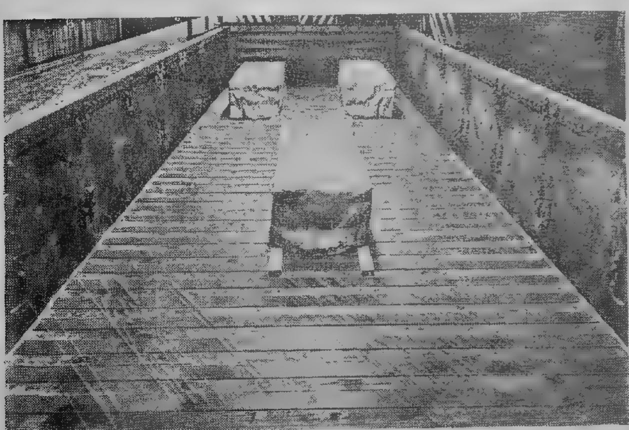
STRENGTH FOR BOX CAR LOADS

Today, there is an increasing use of fork lift trucks for loading and unloading palletized freight in box cars. Wheel loads from lift trucks of 10,000 pounds (20,000 pound axle loads) are common. When a single box car floor plank 1—3/4 inches thick is called upon to resist such a concentrated load, the result is often a break-through. The hat section Armco steel rib has several times the strength of the wood plank under comparable loading.

When there is a concentrated load on the wood nailing strip, the load is transferred to a pair of steel ribs through their flanges. Consequently there is no point of weakness in the Armco freight car floor.



This is how Armco steel ribs strengthen the car frame. Circled welds are four of the ten points at which rib is welded to frame.



Three weatherproofed lifts of steel sheets in an old gondola car with new Armco floor. Note skids nailed to floor planks. This method of loading is ideal for quick unloading with crane.

Damage is often caused to open car floors from dropped loads and the impact of clamshell buckets when unloading aggregates. Wood plank floors cannot withstand it; plate floors become deformed and unsuited for many types of lading.

Wood planks in gondola and flat car floors are usually 2—3/8 inches thick by 5—1/2 inches wide. The corresponding Armco steel rib is several times as strong as the wood plank and can take a more severe beating longer.

Steel plate floors in gondola cars are good for bulk lading, but plates have little beam strength and become bellied even from normal service. The steel ribs of the Armco floor are designed strong enough to remain flat under most service loads.

Concentrated loads and impacts shorten the life of floors. Each plank in a wood floor must serve as a beam Standard wood floor planks do not have the

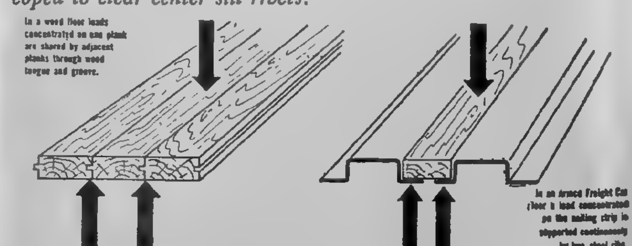
Steel plate floors become bellied, perforated and unsuitable for even bulk loads.

Stripping gondola car floor by cutting out old plate between sills and crossbearers in order to install the stringers. It is unnecessary to remove bolster or center sill cover plate.

necessary beam strength. The Armco hat-section rib has the strength that is needed. It gives the best-known

Welding fillers to side sill of old car. Note installation of stringers made of old 5-inch bulb angles riveted to crossbearers.

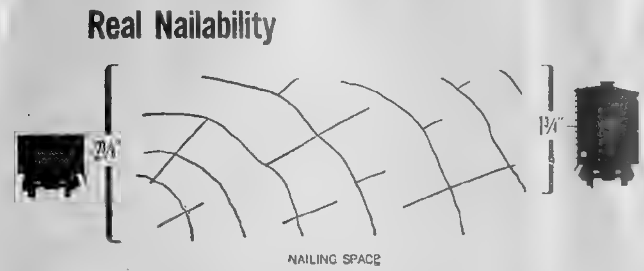
Unloading Armco ribs directly from car by conveyor and laying preparatory to spacing. Note ribs in foreground coped to clear center sill rivets.



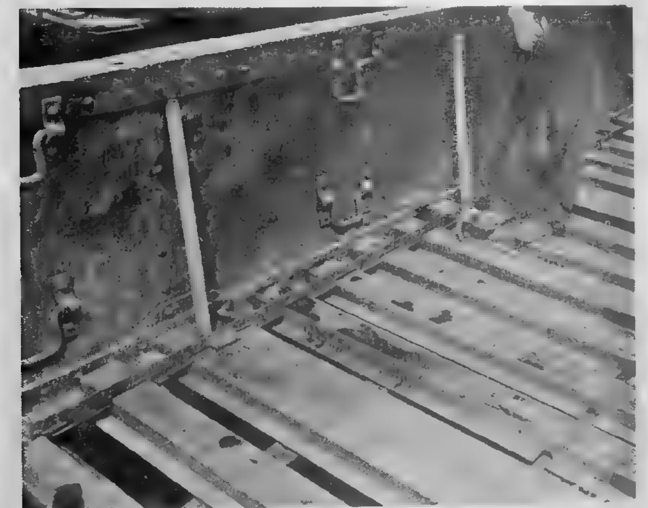
combination of beam strength and floor surface per pound of steel.

EXCELLENT NAILABILITY

Here are actual-size cross-sections of the nailing strips used in Armco freight car floors. The 1–3/4 inch thickness



is for box cars, the 2–3/8 inch for gondola and flat cars. These nailing strips are spaced alternately with the steel ribs the full length of the car, except over bolsters or crossbearers where bolting is impractical. Here Armco standard steel planks or special ribs, designed to fit the car underframe, are fastened by welding.

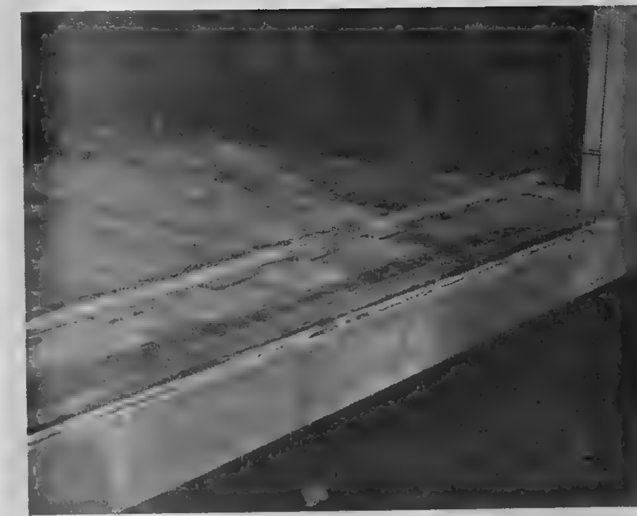


Spacing ribs with template. The one shown is half the length of the car, of welded construction and made to clear special ribs over bolster.

The sturdy wood planks permit easy fastening of skids and bracing and provide the floor with real nailability.

A MULTI-PURPOSE FLOOR

The Armco floor will handle bulk—or unit-lading equally well. This eliminates the problem of selecting a car by floor type. It saves time and money for both the railroad and the shipper in switching empty cars.



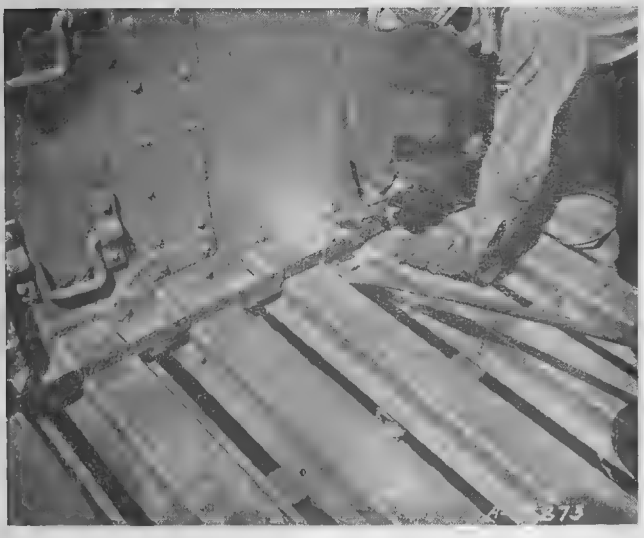
Template of welded pipe used for spacing box car ribs.

In this new box car installation steel ribs are being centered before welding to provide sealing space at car sides.

This is of particular importance in the case of gondola cars. The same car that brings bulk loads into a plant can carry away the manufactured product. Armco freight car flooring is made for fastening bracing and skids in the proper way—with nails. There is no invitation to weld fasteners to plate floor or burn holes for bolts.

RIBS REINFORCE CAR UNDERFRAME

The Armco ribs not only bear the weight of the shipment but reinforce the car frame. Each individual rib is welded to the frame in at least ten places.



Tack welding Armco ribs while spaced with template. Note special pinch bar for holding ribs tightly to side sill while welding.

Laying treated wood planks between spray-painted ribs.

Welding special ribs over bolster.

Centering wood planks with pinch bar. Note chalk marks on steel ribs and car sides to locate bolt holes.

Welds are made on both sides of the ribs, two at center sill and two each at stringers and side sill angles. Resistance of the car underframe to twisting and racking is increased greatly by this strong welded lattice.

A SOUND INVESTMENT

The life of an ordinary wood-plank floor is limited to an average or about five years. The Armco floor will last much longer. It's steel ribs should be good for the life of the car.

The wood nailing strips are not required to resist concentrated loading or heavy impact. That is the function of the steel ribs. The wood planks wear chiefly from abrasion, and from this they are partly protected by the top section of the steel ribs.

This protection of the wood plank from mechanical damage is favorable to the use of wood preservatives. They will extend plank life.

Drilling planks to match existing bolt holes.

Armco freight car floors help create satisfied shippers, reduce costly claims for damage and loss. The danger of heavy concentrated loads breaking through a weakened car floor and causing a serious accident is eliminated.

Armco freight car flooring will also reduce shopping time and consequent loss of revenue from out-of order cars.

DESIGN DETAILS

Sketch 1

Sketch 1 gives dimensions of standard gondola car ribs and planks. Method of bolting wood plank to side sills and stringers shown at left is used when existing bolt holes match wood planks. At center is bolt with floor clip, another method of fastening wood plank. At right is an Armco steel plank used over bolsters and cross-bearers where it is not practical to bolt wood planks.

Sketch 2

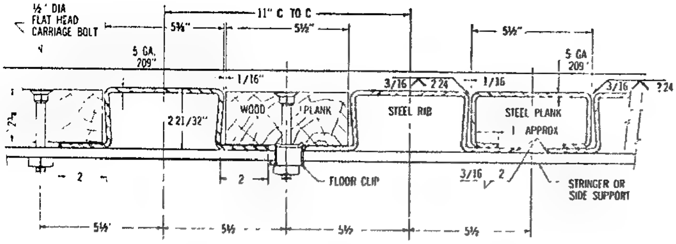
This drawing shows how steel ribs are welded to side sills, stringers and center sill. The arrangement shown to left of center line is used in older cars. Here, a steel filler strip is welded to the center sill and the steel ribs in turn are welded to the filler strip.

Drawing indicates how wood planks are fastened by bolts through side sills and stringers as previously shown in Sketch 1.

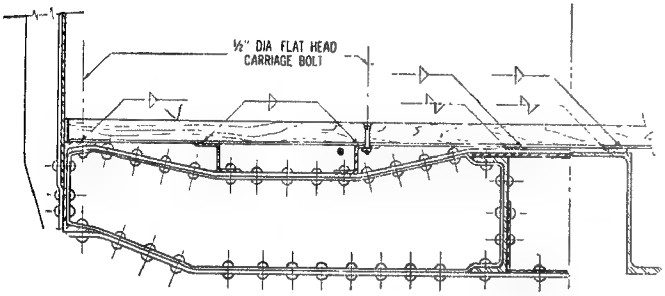
This box car installation uses floor clips similar to type shown in Sketch 1, to fasten wood planks to steel ribs and stringers.

Pouring car cement after inserting galvanized closure strip and filling crevice with sawdust.

The arrangement to the right of centerline of car shows the half-section of center sill used in newer cars.



Sketch 1



Sketch 2

Sketch 3

Sketch 3 shows special ribs supplied for use over gondola cars bolsters. Note how floor level is maintained and rivet heads avoided. Armco supplies these ribs made to measure for your cars and ready for installation.

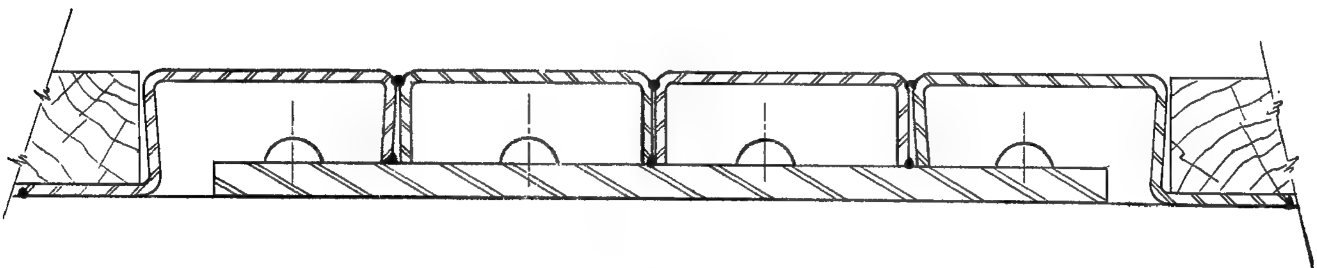
Sketches 4-A and 4-B

(4—A) Two single flange ribs with one short leg to fit cross-bearer cover plate used in one gondola car installation.

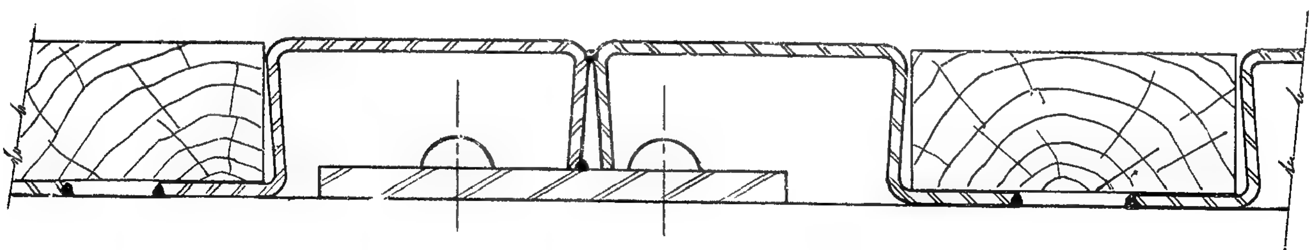
(4—B) Channel shaped rib in another gondola car installation. Design by Armco engineers from drawings of car.

Sketch 5

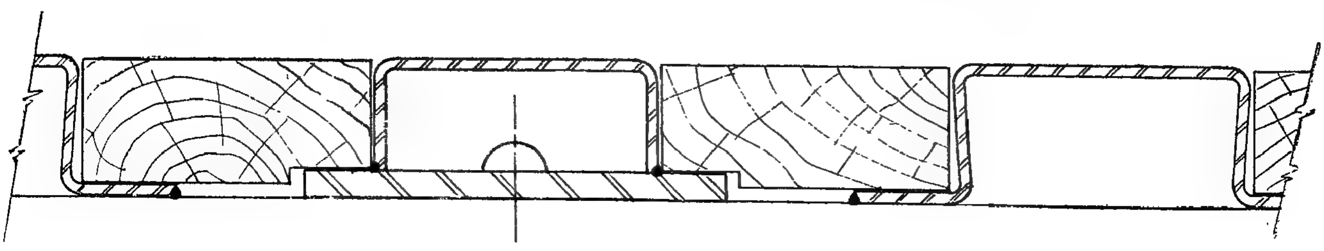
To seal sills, space between floor and side sill angle is filled with car cement. Sketch at lefts shows seal for



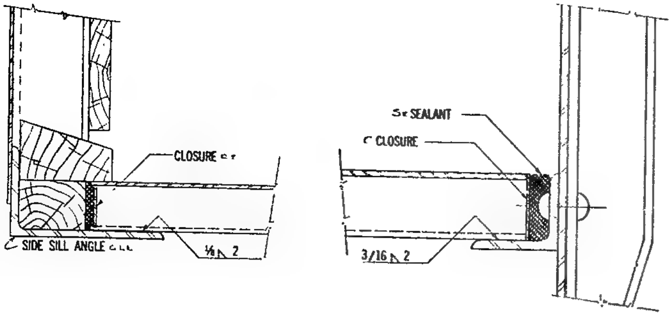
Sketch 3



Sketch 4-A

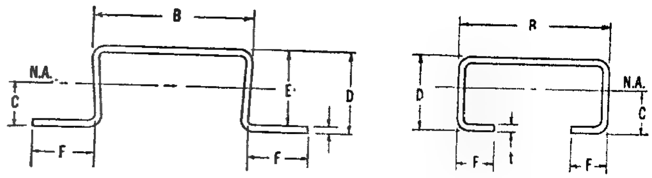


Sketch 4-B



Sketch 5

box car with wood filler strip and grain strip. The rib is supplied with the closure welded in place. Detail at right shows sill seal for gondola car. The sheet metal closure strip is laid against the edge of the floor before the car cement is applied.



Sketch 6

(DIMENSIONS & PROPERTIES)

Sketch 6 and Table

Here are the cross-sectional dimensions and structural properties of standard Armco steel ribs and planks. Lengths are supplied to suit requirements. Armco engineers will design any special or modified ribs needed.

	t in.	*B* in.	*D* in.	*E* in.	*F* in.	*I* in.^{4}	*S* in.^{3}	*C* in.	*Weight lbs. per 1 in. ft.*
Ribs for Gondola and Flat Cars	.209	$5\frac{3}{8}$	$2\frac{21}{32}$	$2\frac{15}{32}$	2	3.21	2.26	1.42	9.83
Plank* for Gondola Flat Cars	.209	$5\frac{1}{2}$	$2\frac{15}{32}$	—	$1\frac{5}{32}$	1.94	1.25	1.55	8.10
Ribs for Box Cars	.135	$4\frac{1}{2}$	$1\frac{15}{16}$	$1\frac{13}{16}$	2	1.02	1.03	.99	5.47
Plank* for Box Cars	.135	$5\frac{1}{2}$	$1\frac{13}{16}$	—	$1\frac{3}{32}$	.66	.56	1.18	4.82

*Steel planks are for use over bolsters or other cross members when wood planks cannot be bolted at these points.
I = Moment of Inertia
S = Section Modulus (I/c)
C = Distance from extreme outer surface to neutral axis

GENERAL COMMENTS ON DESIGN

1. When replacing worn-out wood floors, the car underframe requires few or no changes. When applying the Armco floor to gondola cars with worn-out steel plate floors, stringers must sometimes be installed between cross-bearers. This requires stripping of the old plate floor with cutting torch. In many cases, depending on car design, filler strips or shims must be welded to center sill, and occasionally to side sill angles, to provide a level foundation for the new floor.

2. Armco steel ribs and planks are usually supplied in hot-rolled open-hearth steel. Copper-bearing steel will be used if specified.

3. Welding symbols in Sketches 1 and 5 indicate location of fillet welds, their size, length and spacing.

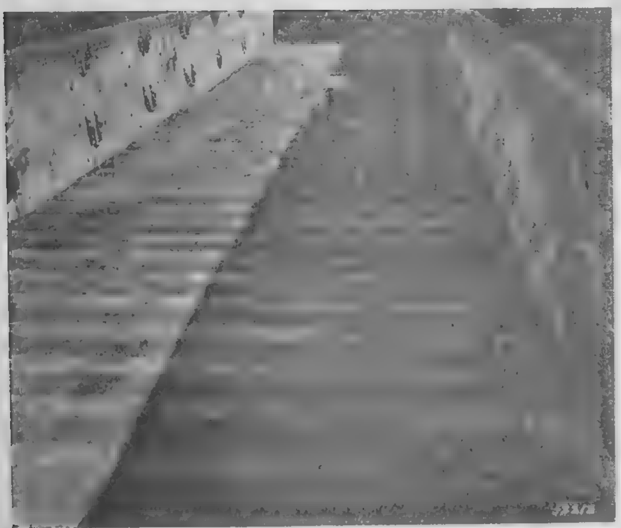
4. All welding required in installing the Armco freight car floor can be performed downhand (from above).

5. Dimensions of steel ribs and planks shown on sketches are for gondola cars. Standard ribs and planks for box cars are thinner and lighter. For dimensions see Table of Dimensions and Properties.

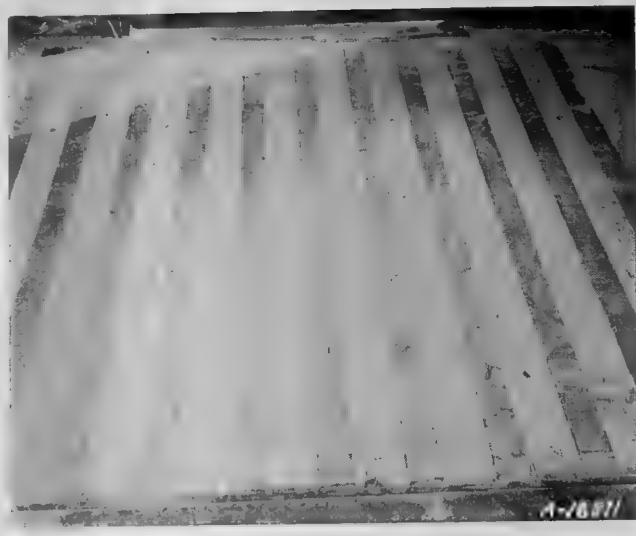
6. Where it is necessary to clear rivet heads in cross members, ribs will be supplied coped (holes punched for clearance) or part of the flange and leg may be omitted as shown in Sketches 3, 4—A and 4—B.

7. In drop-end gondola cars, the last one or two flooring members at both ends of car can be wood planks to more easily accommodate the hinges for the drop-ends.

8. Clips and bolts shown in sketches are representative and satisfactory types. Others may be used at the discretion of the railroad or car builder.



The proof of the pudding. This is the Armco freight car floor shown in photo 1 after 3 years of hard service.



An Armco box car floor after two years of service.

HOW TO INSTALL ARMCO FLOORS

Here is the general procedure for the installation of Armco freight car flooring :

1. When replacing a worn-out floor, the old one must first be removed. Then, if necessary, top surfaces of side sill angles, stringers and center sill are levelled to permit steel ribs to make full contact at all supports. This is done by welding steel filler strips to those surfaces low in elevation to bring them into line. Location and dimensions of these fillers is determined in advance from blueprints of car frame to eliminate on-the-job figuring.

2. Lay all ribs required for car in correct relative position. Make sure that any special or coped ribs are at the points for which they are designed.

3. Tack welding the first steel ribs at bolster or other point at which precise location is required. Then work toward center and both ends of car using templates to space ribs.

4. While spaced accurately by templates, weld ribs wherever they make solid contact with side sills, stringers and center sill.

5. If necessary, jack up stringers so that they meet the bottom surfaces of the rib flanges before welding. In old cars ends of steel ribs may have to be forced down to bear against side sill angles.

6. After finish-welding ribs, lay any steel planks that may be required, as over bolster, and weld in place.

7. Spray- paint ribs and steel planks. While this is not essential it is quite desirable.

8. Lay wood planks in place between ribs, and center so that equal space is left at sides of car for closure strip and seal.

9. Drill planks for bolts. Location of existing holes in side sill angles can be marked with chalk on side of car and ribs.

10. When required, set sheet metal closure strip at sills and use filler and black car cement to seal sides of car.

GOLDEN RULES OF CONDUCT FOR RAILWAYMEN

1. Maintain proper relations with officers and others in the Department in which you work.
2. Use good human relations in your contact with subordinates. Do not make them feel their position.
3. Maintain good public relations with callers and passengers.
4. Be resourceful and find ways and means of doing a job well.
5. Discard the idea of 'Give me some more men to do the job'.
6. Learn the art of getting along with people.
7. Remember the most important thing is to get a job done—not just to do it anyway and somehow but to do it efficiently, safely, economically and expeditiously.
8. Develop the attitude of 'Give me plenty of rock and plenty of wood and just get out of my way'. This typifies loyalty and enthusiasm for work and responsibility.

★ ★ ★

1. Get down to the man on the JOB.
2. Move on the line as often as you can as MEMBERS OF THE PUBLIC and not only as officials.
3. Remember pre-arranged and announced expeditions cannot have the same informative value as surprise inspections.
4. Every railwayman has to be convinced that the work that he does is to his own advantage. He should not think and measure his effort merely in terms of wages which is only a motive force.
5. Every railwayman does a specialised job which has no meaning or usefulness by ITSELF unless it is cohered with each other. There is no meaning or value to the work of a permanent way gang unless there are trains to run over the track.

RAILWAY SIGNALLING CIRCUITS

By B. K. Cooper

Methods Adopted for Steam and Electric Lines

SIGNALLING, in its widest sense, of the control of train movements, was the first sphere of railway working to benefit from electrical apparatus. Originally, this was in the form of the electric telegraph, for as early as 1837 Cooke and Wheatstone demonstrated the use of telegraphy for communicating between Euston Station and the top of the Camden incline, up which trains at that time were hauled by a steam winding engine. In 1844 the telegraph was installed on the Norwich and Yarmouth Railway, two years after Cooke had published a pamphlet urging the importance of a telegraph system in ensuring safe working over single lines.

In later years the railway telegraph developed in two forms, one being the ordinary Morse single-needle telegraph and the other a specialised instrument for "offering" and "accepting" trains from signal box to signal box by a code of bell signals, and for giving a visual indication of whether a section of line was clear or occupied.

To-day the mention of electricity in railway signalling usually suggests the use of colour-light signals and power-operated points, but electrical safeguards associated with mechanical signalling and the operation of the signal box telegraph instruments are of much earlier origin than the first power schemes. Their modern developments are still to be seen on many miles of main and branch lines.

ELECTRIC LOCKS

The principle of the block system of railway signalling, in which the line is divided into block sections and only one train is normally admitted to a section at a time, is generally familiar. An electric lock on the signal lever giving admission to a section, released only by receiving "line clear" from the box ahead, is one of the methods of ensuring compliance with the rules of block working. A further step is necessary in this electrical safeguard, however, for when the signal has been pulled "off" (i.e. to show "line clear") and restored to "on" (danger) after the train has passed, it must be locked again until the signalman ahead has sent "line clear" for a second train.

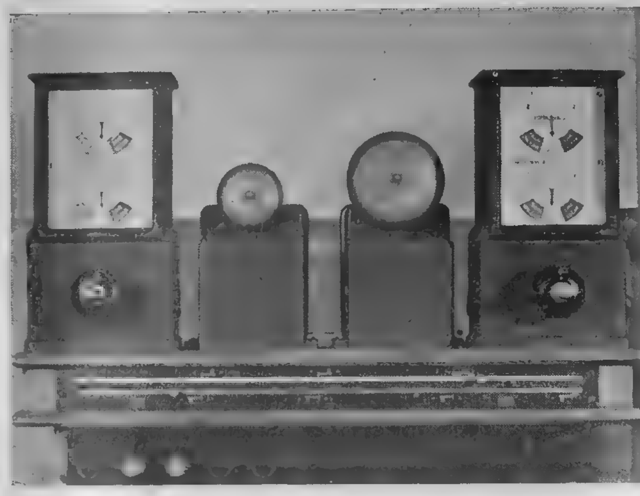


Fig. 1. Block telegraph instruments and bells

Block telegraph instruments and bells of the type used for exchanging messages between signal boxes are shown in Fig. 1. In the type illustrated the bell code is transmitted by operating a plunger, the head of which can be seen on the front of the case. It is concentric with a commutator handle which is turned to right or left to change the indicating pointer from its central "line closed" position so as to show "line clear" or "train on line." The instruments are connected by a three-wire circuit and energised by 10 V batteries.

Considering two successive signal boxes, A and B: when the signalman at B is able to accept a train from A he operates the commutator handle of his block telegraph instrument to set it, and A's also at "line clear." A circuit by which this action can be made to unlock signal 1 is shown in Fig. 3.

The circuit which energises A's block telegraph instrument to "line clear" also energises the relay LC, causing its contact to change over and make a circuit through the coil of the lock on the lever for signal 1. When this lever is pulled, contacts A, which may be controlled by the signal operating rod, are opened and the release relay is de-energised. The feed to the lever lock coil is therefore broken at contact 2, so that the lock is no longer held released and will drop back into

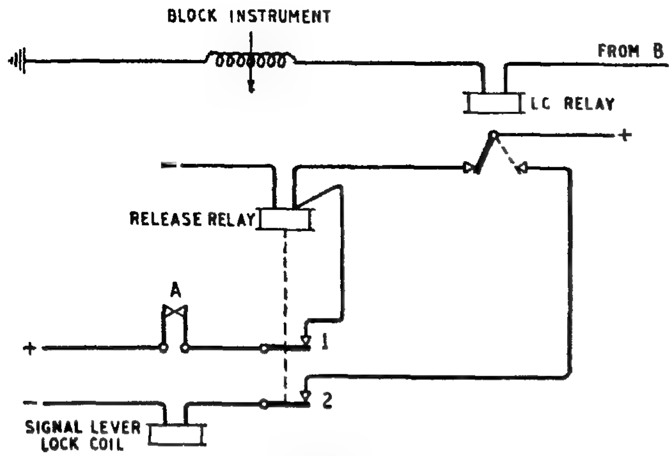


Fig. 3.—Locking circuit for signal lever controlling entry to a block section

position as soon as the lever is returned to the " danger " position. In this condition the feed to the release relay is still broken at contact 1. The release relay cannot be re-energised to prepare the circuit for unlocking the signal lever until the LC relay has been returned to normal by B restoring his block instrument to " line closed", as a preliminary to sending the next " line clear".

In B box, when "train entering section " is received by bell signal from A, the signalman sets the block instrument at " train on line", the indication being repeated at A. This action energises and releases a lock on B's signal 2 and enables him to pull it " off." The block instrument is now locked at " train on line" and remains so until the train has passed out of the section. Consequently, B cannot again give " line clear" to A until the section is unoccupied.

One method of proving that a train has passed a given point—in this case the end of the section—is a rail treadle. The type of treadle illustrated in Fig. 4 operates by the flexure of the rails under the weight of a train causing mercury to be pumped into a float chamber so that contacts attached to the top face of the float are operated. In this way a circuit can be made to the coil of the lock on the block instrument commutator handle.

RELAY INTERLOCKING

When electrical methods were applied to the actual

ANNOUNCEMENT

We have pleasure in announcing to all our Readers and Advertisers that we propose to bring out a special Number to our Magazine entitled " EIGHTH ANNIVERSARY TRANSPORT & ENGINEERING" sometime in January 1958.

Editor

Fig. 4. Mercury type treadle attached to rail, with cover removed to show contacts operated by the passage of trains

operation of signals and points, it was no longer necessary to provide the large levers required to give the necessary purchase with mechanical working. Consequently, miniature levers controlling electrical contacts were used. Electric locks of the type described already were applied to the levers, but often the interlocking between levers which controls the sequence in which they can be operated remained mechanical. An example would be the interlocking of the levers controlling signals 2A and 2 in Fig. 2 to ensure that the distant (or warning) signal 2A could not be pulled "off" before the "stop" signal 2. Eventually the use of electrical controls for interlocking as well resulted in the replacement of levers by key switches of various types and the application of relays to produce the effects of interlocking. This principle is known as relay interlocking. No physical locks are required on the key switches because the relays prevent dangerous conditions being created in the event of incorrect operation.

A separate key switch may be provided for each function, such as the control of signals and of points, but it was a logical step forward to make a single relay set the points and then clear the signal for a particular route. Schemes based on this principle are known as route relay interlockings, and are the usual form of new power signalling to-day.

Fig. 5 shows the elements of route relay interlocking. A and B are key switches, shown in the "normal" position in which the signals are at "danger" and the points are set for the straight-through route (route B). In this condition the N coil of the signal relay is energised and both coils of the point relay are de-energised, although its contacts remain latched in the position to which they were last operated.

If a train is to be signalled to route A, the A switch is turned. Although this breaks the feed to the N coil of the signal relay, contacts 1 and 2 remain latched in. Consequently a circuit is made to the R coil of the point relay, causing the points to be reversed (i. e. set for the diverging route). Energisation of the R coil also closes contact 3, so that a feed is made to the R coil of the signal relay. This clears the signal for route A and simultaneously unlatches contacts 1 and 2. It will be seen that even if switch B is now inadvertently operated there will be no feed to the point relay N coil and consequently the points cannot be changed. Similarly, the signal for the straight-through route cannot be cleared, for the energisation of the point relay R coil has released contact 4.

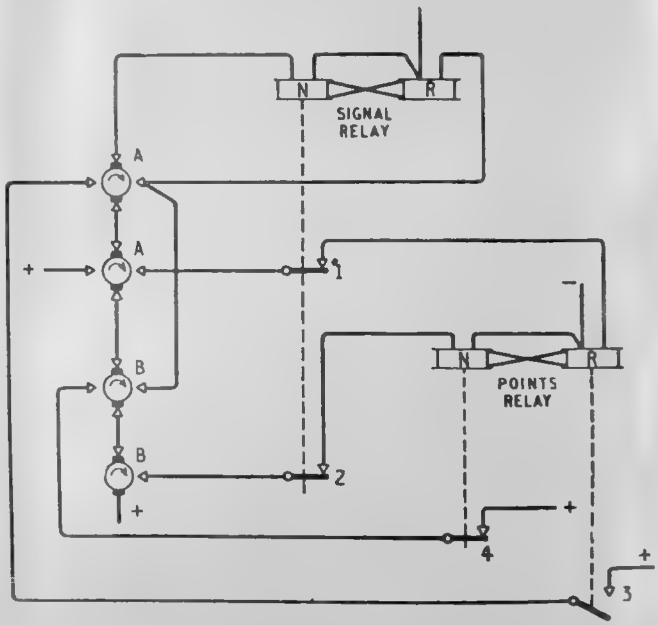


Fig. 5.—Elements of route relay interlocking.

The form taken by the control switches and their arrangement in the signal box have several variations. A separate key may be provided for setting up each route, or a single key in conjunction with a selector may control two or more routes. An alternative arrangement is for a separate key to be allotted to the beginning and the end of a route, both having to be operated in order to set it up. The keys may be located on a diagram of the tracks in positions corresponding to those of the actual signals and points they control (Fig. 6), or on a desk in front of the diagram.

In practice many control circuits additional to the simple ones described in the above example are involved in relay interlocking. Some of these are track circuits which detect the presence of trains and prevent premature clearing of signals or changing of points. Electric point machines, having thrown the points, bolt them in position, and detector contacts associated with the bolts ensure that the circuits controlling the signal are not completed until the bolt is home.

The track circuit takes various forms and has an extremely wide range of functions which it exercises through multi-contact relays. In addition to its safety controls when signals and points are operated by signalmen, it is the basis of automatic signalling in which, over long distances, signals are controlled, and the requirements of the block system maintained, by the passage of the trains themselves. In the simple d. c. case on steam-worked lines, the track-circuited sections of line are isolated electrically by means of insulated rail joints from their neighbours. A battery is connected across the rails at one end of the track circuit and a relay at the other end. When no train is present the relay is energised, but when a train enters the track circuit its wheels and axles shunt the relay coil and cause its contacts to be released. One application would be to use a track circuit instead of a treadle of the type described earlier in connection with electrical safeguards in mechanical signalling. Release of the relay by the passage of a train could then be made to unlock a block telegraph instrument from "train-on-line" and so enable a second train to be accepted.

On d. c. electrified lines where the running rails are used as traction current return conductors, simple track-circuit systems of the type just described need modification so that the apparatus will be immune from the effect of the return current from the trains. Recent examples of modifications for this purpose have been seen on the Chelmsford and Southend extensions of the British Railways, Eastern Region, 1,500 V d. c. electrification in the London area, where a.c. track circuits have been substituted for d. c.

AUTO-IMPEDANCE BONDS

If only one rail is needed for the traction current, it can serve as a common traction and track circuit return conductor. The track circuits are then formed by the insertion of insulated joints in the second rail and are known as single-rail track circuits. Where both rails are needed for the traction return, as on

Fig. 6. Route relay interlocking control panels at Liverpool Street Station signal box.

densely-occupied or steeply-graded sections of line, means must be provided for the d. c. to by-pass the insulated rail joints necessary for defining the a. c. track circuits. A method of effecting this by the use of auto-impedance bonds is shown in Fig. 7.

Referring to the figure, it will be seen that the d. c. flows in opposite directions through each half of the bond windings so that the magnetic fluxes cancel each other and the impedance presented to changing current is zero. On the other hand, the bonds present their normal impedance to the track-circuit a. c.

In the typical arrangement shown, T is a 1 : 1 transformer and the feed capacitor C_1 is adjusted so that the voltage across the rails is between 3 and 9 V, this low value being necessary to ensure that the relay is not shunted by leakage through damp sleepers or ballast. R is known as a two-element relay, being held operated by a state of balance between the torques of two coils, a condition obtained by adjustment of the phasing capacitor C_2. Shunting of the track by a train disturbs the equilibrium and causes the relay to be released.

Where lines already equipped with power signalling suitable for use in conjunction with d. c. traction are to be converted for industrial frequency a. c., the choice of track-circuit frequency will demand a sufficient difference between the signalling and traction frequencies for reliable discrimination. This may be achieved by generating and distributing a special signalling supply at 83.3 c/s. New signalling schemes for industrial-frequency lines where there is no risk of extraneous

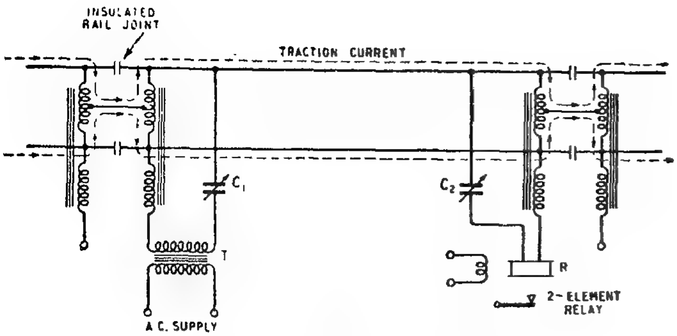


Fig. 7.—Double-rail a.c. track circuit with auto-impedance bonds

interference from direct current are likely to be d. c., but a. c. at 83.3 c/s might be adopted where such a risk exists.

A contract awarded in February to the Siemens and General Electric Railway Signal Co., Ltd., was the first to be announced since the 50 c/s traction system was adopted by British Railways, for signalling modifications arising out of it. On the lines concerned, from Colchester to Clacton and Walton, single-rail d. c. track circuits and protection of d. c. signalling apparatus by series inductances will be suitable for the most part, but two-rail track circuits and a special frequency will be required on routes such as Liverpool Street to Chelmsford and Southend-on-Sea. Here the 50 c/s signalling circuits installed recently for immunity from d. c. traction current interference will have to be adapted for immunity from a future traction supply at their present frequency. In addition, before the change-over to industrial-frequency traction takes place, the modified circuits will be required to operate for a time in conjunction with the existing 1,500 V d. c. supply and not be affected by it.

The natural desire to use the industrial supply for all purposes has led in France to the development of an alternative method with valve oscillators generating a frequency of 1,000 c/s. The oscillators are fed through transformers from the 50 c/s mains and incorporate a grid-blocking circuit which breaks up the output into wave trains of 13 millisec duration, followed by interruptions of 37 millisec. Consequently the basic 1,000 c/s frequency carries a 20 c/s coding. In this way additional security is gained from interference with the signalling circuits by harmonics of the traction frequency, a point of particular importance when rectifier locomotives and motor coaches are used. Amplifiers are used at the relay ends of the circuits to ensure satisfactory holding of the relays in spite of the attenuation of the track-circuit frequency in the rails on long sections.

POWER SUPPLIES

It was shown at the beginning of this article that electrical circuits and apparatus are widely used in many circumstances other than those of complete power signalling schemes. While at one time primary batteries were a common source of supply for items such as block instruments, lever locks and isolated colour-light signals (often installed between existing semaphore signals to break up long sections and so help to keep the traffic moving), it is general to-day to use secondary battery and trickle-charging equipment, operating on a normal single-phase supply. Individual batteries, located as close as possible to their associated apparatus, are installed for working signals and points remote from a signal box. Supplies for lever locks, block instruments and nearby outdoor equipment are located in the signal box itself. Colour-light signal lamps are operated at 12 V or 24 V as this enables a short, sturdy filament to be used and makes it easier for the optical system to concentrate the light into a long-range beam. Often the lamps are two-filament types so that, if the main filament fails, a second, lower-rated filament maintains the signal in operation at reduced brilliance—a fact which would be noted by passing drivers and reported. It is now becoming more usual on British Railways to provide two single-filament lamps of the same rating and to bring the second into operation automatically by a relay in case of failure, a warning being given simultaneously in the signal box.

Point machines installed for convenience of long-distance control are often operated from a local 30 V supply, but in complete power interlocking schemes they generally work at 110 V d. c. Where it is inconvenient or impracticable to install trickle-charging equipment and a local battery at points too far from a signal box for mechanical operation, hand-operated generators are often used overseas and to some extent in this country. Although operation of the points is slower than when a battery or mains supply is available, hand generators may save the expense of providing additional signal boxes and staff. Existing semaphore signals may be modified for electric working by means of signal machines comprising a d. c. motor and a reduction gear train for driving the signal arm spindle direct or, if the machine is to be mounted at the bottom of the post, through rodding.

In large colour-light signalling installations to-day power is generally taken direct from the mains and every effort is made to obtain supplies from two sources with the largest possible measure of independence. One of these would be a normal and the other

a standby supply, generally with automatic change-over in the event of either failing. It is now becoming increasingly common to provide in addition a standby diesel-alternator set with automatic starting arrangements.

At the signal box to which the power is fed, duplicate transformers are installed to provide a 110 V supply for control circuits, point machines and colour-light signals, the colour-light lamps being connected to local step-down transformers. In the larger installations it is usual for several signal boxes and other places to need a power supply, and the method preferred is to install duplicate step-up transformers feeding a ring main or duplicate cables. A distribution voltage of 650 V is chosen when possible in the interests of economy in the size of cabling.

The extension of power signalling, a major item in the expenditure of £100 million allotted to signalling and telecommunications generally in the British Railways' modernisation programme of 1955, increases the concern of the signal engineer with supply and distribution questions. As in the field of traction, therefore, there is taking place a progressive overlapping of interests between the railway specialist and the general power engineer. The applications of electricity in railway signalling are so numerous and varied that a single article can do no more than prepare the way for further study of a subject of growing interest to many sections of the industry.

Acknowledgment is made to the Siemens and General Electric Railway Signal Co., Ltd., for assistance in the preparation of this article and supplying illustrations.

IMPORT OF STEEL ITEMS FROM JAPAN

A Japanese steel mill is reported to have signed a contract for the export to India of 9,500 tons of steel plates and 4,300 tons of steel rail which constitute a part of the 560,000 tons of steel products being sought by the Indian Government for the railways. Negotiations reportedly are under way between some Japanese companies and the Government of India for the supply of 120,000 tons of steel products for rolling stock. Besides, a Japanese trading firm is reported to have accepted a contract for the supply of 11,000 tons of steel plate to India.

GOLDEN RULES OF CONDUCT FOR RAILWAYMEN

1. Do you plan your work daily? Get the more essential things done first and do not neglect the important ones sidetracting them to the fag end of the day.

2. Do not express casually careless opinion. Never venture forth an opinion unless asked for it.

3. Remember that most of our mental worries come either from trying to fight life hard or from trying to run away from life. Do neither.

4. Learn to accept people as they are, love them, respect them, praise them, encourage them, differ with them, but above all, learn the priceless art of give and take.

5. Cry neither for the moon, nor over spilt milk.

6. Accept the things that you cannot change; have the courage to change the things that you can, and possess the wisdom to know the difference.

7. Do not drive too hard a bargain with yourself.

8. Accept life as it is—its wonders, changes, disappointments, frustrations etc., etc.

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CONTENTS

EDITORIAL NOTICE

The Editor invites contributions to the Magazine on a variety of topics—short stories, technical features written in simple English understandable to the laymen, Aspects of Railway Working, places of tourist interest, News from home line, activities on Railway Institutes etc. All copy should be brief and typed as far as possible.

Photographs illustrating social functions, sports events, scenic sports etc. are also invited. All contributions should reach the Editor not later than 5th of each month. Rejected Mss. will be returned provided sufficient stamps for postage are enclosed. No responsibility will be borne for copy lost in transit.

Views expressed in this Magazine should not be taken as having official authority.

All correspondence should be addressed to the Editor, "Southern Railways Magazine", Post Box No. 17, Tanjore, (S.India).

Automatic Train Control on the German Federal Railways

*By D. W. Chilian**

SOON after the 1st World War, the German Railway recognized the necessity of introducing a system of Automatic Train Control by which it should be possible to enforce a train moving on any line section to adhere strictly to the signals indicated to it for its safe passage along this section. This system should prevent the engine driver to pass any signal at 'danger' and enforce an automatic braking of the train in case he should not respond immediately to the signal.

The development of such a system which is commonly known as Automatic Train Control, was substantially pioneered in Germany by the firm of Siemens & Halske, and this system is also known on the Continent under the abbreviation INDUSI. The vital problem for such a system was a reliable transmission of controls from an apparatus on the track to the running train at speeds ranging from nearly zero up to the highest ones, being at this time 100 m.p.h. The system adopted was capable of a reliable transmission of multi-aspect signal controls by non-mechanical means.

The German State Railway at this time selected a 3-frequency system, thus allowing 3 different controls to be transmitted simultaneously.

From 1935 up to 1940 a total number of 1000 engines, mostly steam ones, have been equipped with this apparatus and on approximately 2200 miles of double line sections a total number of 10,000 track equipments have been installed. This apparatus is still in service with the present Federal Railway of Western Germany. It has proved its reliable operation during the strenuous years of World War II and after when only a very limited supply of spare parts was available and little maintenance could be spared on this equipment. It is further proved that in many cases severe train disasters could be avoided and heavy damages thereby prevented.

It was possible for Messrs. Siemens & Halske to improve the pre-war system still further in close co-operation with the Federal Railway. Thus according to the concepts of modern manufacture and technique, the vital parts of the equipment could be made much smaller in size, the apparatus could be made suitable for all existing traffic conditions and the power consumption of the engine equipment could be reduced considerably.

What is now the reason for such Automatic Train Control equipment being employed in many technically advanced countries?

The safety in railway traffic and the improvement of the operating conditions has drawn much benefit from the introduction of modern power signalling, by track circuiting of big yards and by Automatic signalling on open line sections. It is, however, known that all such arrangements cannot provide an ultimate protection of the train traffic, since its safety also depends on the watchful eyes of the engine driver. Thereby the human element cannot fully be eliminated, as has been proved by many fateful train disasters.

The driver is compelled to make his driving fully dependent upon the indications of signals. For properly recognizing their position good knowledge of the section is required. Short sections of slow driving which may be provided permanently or occasionally within the section demand special attention of the driver. On some other sections colour-light signals may

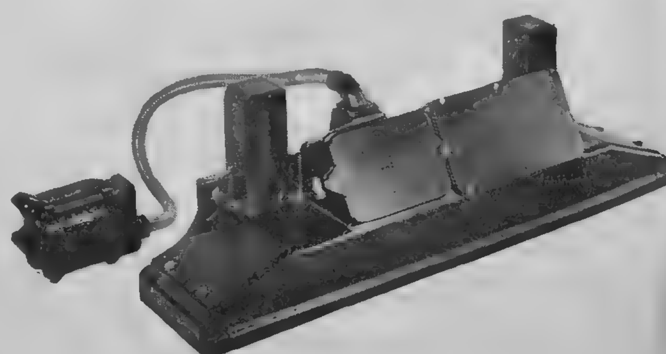

Fig. 1. 3-Frequency Vehicle's Magnet with Plug-in Connection Cable.

* Signal Engineer of Messrs. Siemens & Halske in India.

change intermittently with semaphores. From all this it may be seen that the driver is fully occupied, since he much pay his utmost attention to the signals and at the same time handle his engine. An error in the former, therefore, is not impossible and has been experienced due to the following reasons, mostly leading to major disasters :—

(a) Poor signal view due to foggy or misty weather.

(b) Poor signal view due to smoke from other trains.

(c) Sighting of wrong signals at major yards.

(d) Divertion of driver's attention due to technical faults on his vehicle.

(e) Momentary absent-mindedness or fainting of the driver.

(f) In rare cases even complete neglect of his duties by the driver.

With automatic train control, however, an apparatus is provided which does not require any operation when a signal is passed in 'off'-position, since there is no danger in passing such signal, although for restrictive signal aspects there will be an automatic interference in order to enforce a reduction of the train speed or to come to a stop.

The principle of operation is as follows :—

An electric motor-generator on the engine generates A. C. of 500, 1000, and 2000 cycles p. s. simultaneously. These frequencies are resonated in series with special impulse relay each over impedance coils and condensers, thereby making the current through the relay a maximum. The impedance coils, which are housed together, are mounted at the lower part of the

Fig. 2. Track Magnet on Main Signal (Semaphore Type) for 2000 c. p. s.

Fig. 3. Track Magnet for 1000 c. p. s. at mechanical Distant Signal.

engine on one iron core, thus forming the engine's magnet. (Fig. 1)

On the track at the signal location another magnet, the track magnet is provided the coil of which is also resonated with a built-in condenser for any one of the frequencies 500, 1000, or 2000 c.p.s. (see Fig. 2 and 3). The condenser at the track coil becomes, however, short circuited by an ordinary circuit controller in case of semaphores or a contact of the signal control relay with colour light signals, when the signal is in 'off' position. The track magnet does not require any power supply.

By the track magnet being in resonance with the particular frequency of the engine's magnet, enough power is absorbed at the moment when the engine passes to ensure a safe drop-away of the respective impulse relay. Although the time for this seems to be rather short (it may be only 0.0012 second at a train speed of 60 m. p. h.), it will be sufficient for the very sensitive impulse relay, since its current drops to only 20% of its normal hold-up value.

The drop-away of the respective impulse relay at the engine is the first step to release some other relays, which in turn either force the driver to reduce his speed considerably or in case of an absolute stop signal being passed at 'danger' to effect an enforced braking of the train. The relay apparatus will operate a certain air valve. This valve will open the pipes of the air braking system of the train, similarly as the pulling of the chain for the emergency brake.

The operating sequence of Automatic Train control has been laid down for the German Federal Railways in accordance with the operating conditions and train speeds prevailing on this railway. Since the first sections to be equipped with this new apparatus in 1934 were trunk lines with high speed traffic, the 3-frequency system was adopted.

By this system three different phases are observed for influencing a train on the run :—

1. At a Distant Signal showing either caution or attention aspect by the frequency of 1000 c/s.

2. At a distance of approximately 160 yards in the rear of any main signal showing danger or caution position by the frequency of 500 c/s.

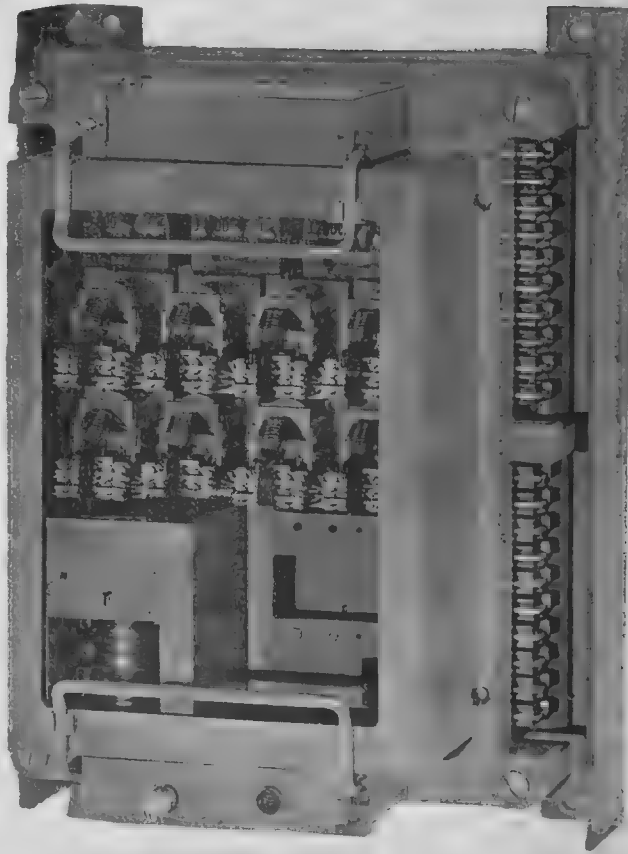

Fig. 4. Plug-in type Relay Unit on Mounting Frame.

3. At an absolute stop signal displaying 'danger' position by frequency of 2000 c. p. s.

In order to enforce a halt of the train at least 220 yards behind an absolute stop signal, which is the maximum overrun distance normally provided on main lines of the Federal Railways, the reduction of speed for trains at highest admissible speeds i. e. 100 miles per hour has to be started at the distant signal. When the train is, therefore, passing a distant signal at either caution or attention position, an automatic transmission must take place at this location. By intercepting the 1000 c. p. s. resonance, the impulse relay will initiate another time relay, a contact of which will delay the enforced breaking for about 5 seconds. This is provided to give the driver ample time to respond by pressing a certain push-button, indicating that he is aware of having passed the distant signal in restrictive position. This button may be called the vigilance button or also acknowledgement key. If the driver, however, neglects to do

so, enforced braking will be effected after 5 seconds having passed.

To control that the driver continues his breaking effort after releasing the vigilance button, after further 22 seconds a speed check-up is performed through another contact of the time relay in connection with the speed indicator of the engine. If then the train speed is still above 55 miles per hour, the enforced braking will take place immediately.

By any mistake of the driver it could happen that although he had reduced his speed to below 55 m. p. h., he continues with this speed without reducing further. For this reason, the other speed check-up at 160 yards in rear of the main signal is introduced. The drop-away of the 500 cycles impulse relay will bring about an immediate check of the speed, which, at this point, should not surpass 40 m. p. h. Otherwise, enforced breaking will take place instantly.

The last control will be exercised at the main signal in 'danger' position. There in all cases an enforced breaking will bring the train to an absolute stop by intercepting the 2000 cycles track magnet.

By the described operating sequence with the 3-frequency system, a four-fold control is exercised over the train movement, which again may be recalled as follows :—

(a) Vigilance Test at the distant signal

(b) Speed check-up after 22 seconds restricting the train to a maximum speed of 55 m. p. h.

(c) Speed check-up 160 yards in rear of the main signal at danger, restricting the train to 40 m. p. h.

(d) Enforced breaking at the main signal.

This control seems to be sufficient to ensure that the driver adheres strictly to the signals indicated to him and that the human element is fully eliminated, thereby taking no risks whatsoever.

It may be pointed out that such a system of automatic train control is very flexible and also allows application at level crossings, the gates of which may not be interlocked with the signal. Secondly, it may be used for certain type of cab-signalling, a system which has been adopted successfully in the United States of America.

The following explanations can be given regarding the equipment in use :—

The three-frequency generator is normally driven by the 24 volts train lighting supply. To ensure constant frequencies, a special governor is provided, which works automatically.

The relay unit incorporates in a plug-in type unit all switching arrangement including the time relay. (See Fig. 4)

The air-brake valve including its switching gear is built into a separate housing, which incorporates also the main switch for the equipment. (See Fig. 5)

The engine's magnets including its coils, condensers etc. are housed in a separate device for which also plug-in type connections are provided.

The speedometer is equipped with contacts for certain speeds and provides also a registering device.

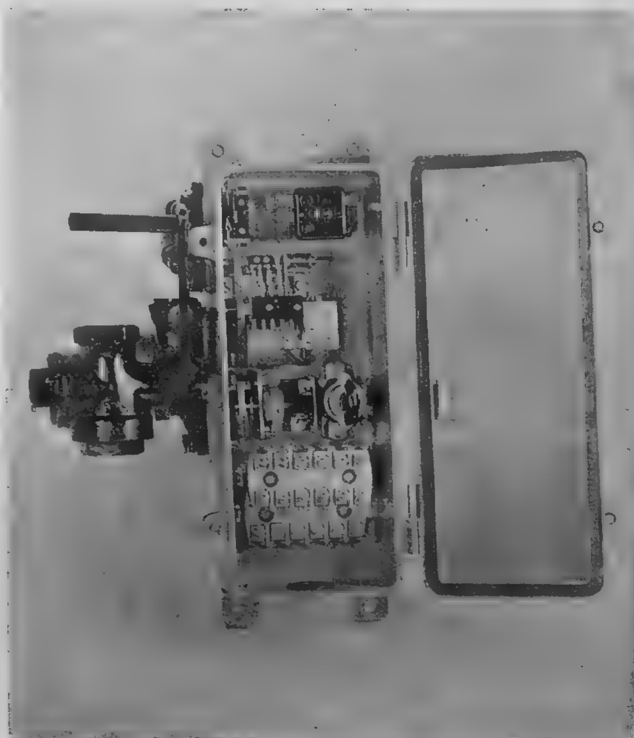

Fig. 5. Brake Valve Unit for Diesel or Electric Trains.

The track devices are normally installed on the right hand side of the track, and their resonating frequency is chosen according to the designation of the signal or its location. Thereby main signals are always equipped with a 2000 cycles magnet and in case they should cover any particular danger point a 500 cycles magnet is placed 160 yards in rear.

Each track magnet contains in its casing from light metal alloy its coil on a soft iron core and a high quality capacitor. The free space of the casing is filled up with a special compound from which only connecting cable to a special pothead emerges. From there a short ground cable is lead to the respective signal, over which the capacitor is shorted when the signal is in off position. The track magnet becomes mounted on two sleepers beside the rail. It is supplied already fully resonated and requires no readjustment at the track, since it is not submitted to wear and tear by any mechanical operation.

The described system of Automatic Train Control has proved to work successfully on the German Federal Railways. Other, eventually less elaborate systems are used by other railways of the world. Another much simpler system working on the magnetic principle has also been developed by Messrs. Siemens & Halske and is mostly employed for secondary railways with lower speeds or for suburban traffic only.

The expenses for introducing Automatic Train Control will be heavy at the beginning, but they will certainly result in an overall .reduction of accidents, if not even avoid major train disasters. They will also enable the railways to run certain trunk trains at highest speeds without taking too much risk from the signalling side. It is, therefore, believed that Automatic Train Control must have some future on the Indian Railways.

(By Courtesy: "The Indian Railway Engineer", Bombay.)

First Aid Fire Extinguishers for Railway Workshops

THIS article is written as a guide to all who may be called upon at a moments notice to use extinguishers against an actual outbreak of fire. It is not intended to expound the great value of first aid fire extinguishing appliances to industry.

Tens of thousands of extinguishers are installed in commercial buildings throughout the country—from the numerous and large workshops of the State Railways to the small individually owned premises. As these extinguishers are of extreme value in the event of fire, it is therefore, important that the handling of the different types should be understood if the full benefit is to be obtained, as there is no single type of extinguisher which is effective against every kind of fire.

The information given here will assist those responsible for property and also life, who are considering the necessity of equipping premises with fire extinguishers to select the appropriate types to cover their particular risks.

First aid fire extinguishers are divided into four main classes, and brief details of each, and how they should be used are as follows :—

CLASS—I WATER TYPE (SODA-ACID)

This is a general-purpose extinguisher and will effectively cope with all fires involving timber, fabrics, paper, straw and all other freely burning materials. The normal capacity of this appliance is two gallons and the filling is composed of 2 gallons of water, into which is dissolved a quantity of pure bicarb. soda and also a glass tube containing a solution of acid. Instructions for setting the extinguisher in action are affixed to the outer casing of the extinguishers and should be carefully followed. The usual procedure is to drive in the plunger, situated at the base; this action shatters the glass tube, thus liberating the acid, which mixes with the soda solution (alkali) and results in the generation of carbon dioxide gas in sufficient quantity to reach the necessary pressure to eject the solution from the nozzle to a distance of 30 to 35 feet. The duration of discharge is approximately 1½ minutes.

When the extinguisher is required for use, the operator should take it reasonably close to the fire before setting it in action. The liquid discharged must firstly be, directed to the base of fire, then worked upwards as control is obtained. The Soda-acid Extinguisher is not effective against burning liquids.

CLASS-II FOAM TYPE

The foam producing extinguisher is used against fires involving inflammable liquids, i. e. petrol, benzine, paraffin, oils, paint, tar. The standard capacity of the hand appliance is two gallons and the filling consists of two solutions, a foam salt and an acid salt. The foam salt is 1½ gallons and the acid salt, ½ gallon, this is housed in a small container which fits inside the main body of the extinguisher. In some models the inner container is sealed to prevent accidental discharge. Instructions for setting in action are affixed to the face of the extinguisher. Generally the extinguisher is turned upside down, and where the inner container is sealed the extinguisher will be fitted with a plunger for the purpose of breaking the sealing disc, thus allowing the two solutions to mix. There is an instant generation of carbon dioxide gas, the pressure of which causes agitation in the extinguisher and discharges a thick foam to a distance of 20 to 25 feet. Duration of discharge, approximately one minute. The quantity of foam ejected is equal to six to eight times the liquid capacity of the extinguisher and is sufficient to cover a surface of 12 sq. ft. with a blanket of foam and so cut off the flames. When dealing with burning liquid in an open container, the operator should stand away from the fire to avoid splashing the surface as this not only retards extinction but may increase the area of the fire. The reason for standing away is to reduce the force of the jet of foam before it comes into contact with the burning surface.

CLASS III-CARBON DI-OXIDE (CO_2) TYPE

This class of extinguisher is most suitable for the protection of electrical apparatus; it is effective for generating and power stations, transformer houses and any premises where electrical equipment is used. The capacity of this type of extinguisher is referred to in lbs. i. e. lbs. of liquid gas. A popular size for industrial premises is one of 10 lb. capacity. It is a non-conductor of electricity, therefore, there is no danger to any delicate mechanism other than that caused by the flames, in fact it is non-damaging to any class of material. It is excellent protection for large kitchens, as in restaurants, canteens etc. The gas is in no way injurious to food stuffs.

CO_2 is an inert gas and extinguishes fire by either diluting or displacing the oxygen in the air. It is, of course, appreciated that combustion cannot be sustained without oxygen. The gas in the extinguisher cylinder or bottle is liquified, and on release to atmospheric pressure has an enormous expansion and it is comparatively easy to get a very high concentration of gas to envelop and extinguish the flames. Carbon Dioxide is equally effective protection for all inflammable liquids.

When using a CO_2 Extinguisher, it is necessary for the operator to tackle the fire at fairly close range in order that the highest possible concentration of gas shall cover the fire. Owing to the very high pressure at which the gas is discharged there is considerable noise whilst the extinguisher is being operated. CO_2 should not be used as protection for freely burning materials as whilst it may cut off the flames, there is lack of penetration which is so very necessary when materials have been burning for sometime and this penetration can only be effected by a high pressure jet, as may be discharged from the water type extinguisher.

CLASS IV—CARBON TETRA-CHLORIDE (CTC)

This extinguisher is generally fitted with a double action hand-pump and is intended for motor cars and commercial motor vehicles. As Carbon Tetrachloride is a non-conductor of electricity, it can be used for the protection of a small switch board, a small dynamo, electric or petrol motor. It should not be installed in buildings unless in very small numbers as there is danger to persons from the toxic vapours which are generated when this extinguishing fluid comes into contact with heat. There are two sizes, one a quart capacity, the other a pint. The actual liquid content in the quart size is 1½ pints, and in the pint capacity, 3/4 pint. The action when using this type of extinguisher is similar to that of an ordinary cycle pump. During the outward and inward thrust of the pump rod, liquid is being discharged, and ceases when the operator stops pumping.

It is very important that a fire extinguisher should be thoroughly rinsed and refilled as soon as possible after being used.

It is essential that fire extinguishers should have a periodical inspection to ensure they are full and in proper order for immediate action.

One very important point, which should be remembered is that the quicker a fire is tackled the more easily will it be extinguished.

NORAL SHALLOW-TROUGHED SHEETING

A new aluminium corrugated sheeting has now been added to the extensive range already produced by Northern Aluminium Company Ltd. This new thin-gauge shallow-troughed sheet is suitable for many panelling applications where flat sheet was previously used; it will provide a stiffer sheeting that has considerable decorative appeal.

The sheeting has 1 in. wide troughs, depressed 1/16 in., at pitches of 2 in., 3 in., 4 in., or 6 in. The edges parallel to the corrugations are given borders of sufficient widths to provide a 1 in. overlap, and at the same time to present a continuous, symmetrical pattern across joined sheets. The overlap may be used for a variety of fixing methods and will give standard effective sheet widths of 36 in. and 48 in.

Primarily designed for caravan builders, to provide an attractive panelling with enough 'shape' to minimise the risk of buckling, the sheeting is also suitable for use in vehicle bodywork generally, building and domestic equipment. It will provide a thin-gauge material with the stiffness of flat sheeting of much thicker gauge in the direction of the corrugations.

Flooring Compositions for Railway Coaches

INDIAN Railways have been using for the last 30 years a special flooring Composition on the floors of passenger coaches, replacing Linoleum, Carpet and Rubber Tiles.

The flooring composition (and the patent dove-tailed wooden base on which the flooring composition is laid) is manufactured by the Oxy-Chloride Flooring Products Ltd., of Bombay. In technical language the compositions are known as Oxy-Chlorides of Magnesia. They are laid down in one piece without joints or uneven surfaces where dirt can easily collect. These floorings are available in a variety of colour, Plain, Mosaic or Mother of Pearl with polished or matt finishes.

The Compositions are used for making Monolythic (one piece) non-crackable floors, partitions, dadoes and ceilings and being composed of the most hygienic building materials, are largely used in Railway coaches, Hospitals, Mills, Public Halls and Barracks etc. The material is prepared in the form of fine powder and is despatched in hermetically sealed steel drums.

In Railway coaches the best results are obtained by laying the Composition on a dove-tailed wooden base which has been patented by the Oxy-Chloride Flooring Products Ltd. Wooden strips are cut by a planing machine so that when assembled they form an inter-locked dove-tailed surface. The dimensions of the wood strips depend on the requirements of the space to be covered. Railways are equipped with Carpentry shops and can easily cut the wood strips in the size and shape required.

As there are no maintenance charges and as the life of the Composition on wooden base is as long as the base lasts, the economy of using this method of floor covering need hardly be stressed. Moreover, it is possible for Railways to utilise scrap wood which otherwise would have to be sold for a song. It may

(Continued on page 12)

Thirtyfive years of Leadership in Cable Manufacture in India

IT may come as a surprise to some readers to learn that the electrical cables and wires, which make such amenities as lighting and fans available to the travelling public, and which also contribute to making modern railway signalling possible, have been manufactured in India for almost thirty five years. In the Indian Cable Co. Ltd., the country has been in possession of a cable-making factory since 1922, located nowadays at its original site in Jamshedpur, Bihar. The intervening years since its inception have witnessed a gradual expansion of the factory, which is now actively engaged in helping to meet the growing needs of the new Indian industrial era for electrical goods of all kinds.

Covering an area of over 150 acres, this important industrial unit, with the new factory buildings now taking shape around it, is rapidly developing to form a sizeable community on its own, situated in pleasant healthy surroundings such as are seldom obtainable in the overcrowded smoky cities. In keeping with an enlightened outlook on modern industrial relations, the Company is providing, as quickly as the present availability of building materials will permit, a steadily growing number of substantial, well-designed houses for its employees, equipped with tapwater, electric lighting and fans, to supplement the many existing quarters. Other amenities such as free medical attention, canteen facilities, and subsidised rations are enjoyed by more than thirteen hundred workers.

The normal basic raw materials for electrical cable manufacture is high-conductivity electrolytic copper. Imported usually in the form of electrolytic copper bars, this useful metal is reduced in Indian non-ferrous rolling mills to the form of thick rods of circular section, and it is from these rods that the factory commences manufacture of its variegated cable and wire products.

The first stage involves the drawing-down of the coils of copper rod into wires of a wide range of sizes by passing them through a series of dies. This process is carried on by the intricate machinery of the factory's Wire Mill. Bare copper wires thus produced, in their hard-drawn state, normally form a substantial part of the factory's output for the market, in both solid and stranded form, hard-drawn copper conductors are in general service as transmission lines, conveying the electricity generated at the many power stations all over India to countless distribution points, whence it is led by networks of electrical cable to bring power, light and comfort into a multitude of factories, offices and homes. With the realisation of the great new schemes for the utilisation of India's river water in hydro-electric generating stations, now in progress, such conductors will be required from the cable manufacturers in thousands of miles a year.

The main direction of the Indian Cable Company's activities, however, lies at present in the production of low-tension electrical conductors, insulated with special vulcanised rubber compounds. These rubber insulated cables and wires are the arteries and veins

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(Continued from page 11)

safely be stated that nearly 30% saving can be effected on the cost price of the former types of wearing surface materials utilised.

As regards wearing properties, it is the hardest known material yet used for flooring. There is no expansion or contraction with the variations of climate. If a portion of the floor is broken or damaged, the affected portion can be renovated without the necessity of reconditioning the entire floor. Owing to its germicidal properties the flooring is insect proof and actually serves as a preservative of the wooden base. A composition floor is fire proof that is, it will not burn but may crack under extreme heat.

The tensile strength of the Compositions compares advantageously with that of cement. After 24 hours the Composition shows a tensile power of 650 as compared with 600 of cement. The tensile strength continues to grow until it reaches the figure of 1200. It takes one ton of pressure per square inch to crush one inch composition which has set.

To meet the requirements of the Railway authorities, the flooring products are subjected to the most stringent tests with regard to durability.

which carry current to lights, fans, refrigerators, tools and machinery wherever electrical energy is used, and are turned out in a wide variety of sizes and finishes in quantities reaching thirty lakhs of yards of finished cables and Wires per month.

In order to prevent the deleterious chemical interaction which would occur if the vulcanised rubber insulation were in direct contact with the copper conductors, the bare wires intended for rubber insulated cable manufacture are given a coating of tin. Hard Drawn Bare wires for insulated cable manufacture, with a few exceptions, also require to be annealed, which process restores their ductility and conductivity.

The varied sizes of conductor in demand are produced by stranding single wires together. The finer gauges of wire, for use in specially flexible types of finished cables and cards are " bunched " to form the flexible conductors required.

Into the production of the special rubber compounds, used for insulating purposes, go raw rubber of the highest grade from Indian plantations and various chemical agents which, blended together, and carefully processed, are designed to yield a durable and efficient insulation, and protective covering for the cables. By the process of vulcanisation the characteristic resilence and wearing properties of the rubber are imparted to the rubber insulation, and also the rubber covering of certain types of finished cable.

Vulcanised rubber insulated cables and flexible cords are produced in a number of main finishes. For the protection of the inner insulated conductors, either a sheathing of special rubber compound may be extruded over them to produce a tough rubber sheathed cable, or the conductors may be lapped with a proofed calico tape and then passed through a braiding machine, which applies a tightly-woven braided outer covering of fine cotton yarn to the insulated cores. Taped-and-braided cables of the latter kind are usually finally passed through a bath of insulating compound, which also helps to prevent the ingress of moisture when the cable is in service.

For train-lighting use, cables of this construction are impregnated with a special flame-resisting compound as protection against short circuits and possible fire risk in consequence. An even greater measure of protection is afforded by using an asbestos braid in place of cotton.

Mechanical strength and security against damage are characteristics of another common type of finished cable, in the construction of which a lead alloy sheath is applied over the insulated cores. For this purpose special equipment in the form of a Lead Press is employed. This is a massive piece of plant in which the molten alloy, reduced to a plastic state, is extruded under pressure around the insulated cores to form a seamless, continuous, closely-applied sheathing.

Cables of the type used in railway signalling systems frequently contain as many as a dozen or more insulated cores, each of which is marked in a specified way to facilitate identification by the railway electrical engineer. For this particular construction the cores are 'laid-up,' that is, twisted and then filled solid by an extrusion process with a special rubber compound, which fills the interstices between the twisted cores. In order to secure the cable against the deleterious effects of exposure to the elements, and possible mechanical damage, further protective covering is necessary. Layers of hessian tape are then applied, and upon this bed of hessian galvanised iron wires are tranded and finally served with further layers of hessian. The finished cable is then finally passed through a weatherproof compound.

Most of us have watched with a certain amount of fascination, the gleaming "eye" of a locomotive headlight shining into the darkness. In order to supply this important piece of equipment with current, a cable of special flame-resisting finish is employed, which is also among the many requirements of Indian railways supplied by The Indian Cable Co. Ltd. Universally in service with the railways, too, is the tough-rubber coupling cable, which ensures the continuity of a train's electrical system by linking the wires from coach to coach throughout the length of the train.

This brief account can give but a limited impression of the widely diversified nature of the Indian Cable Company's production. A more detailed description would have to take cognisance of the services rendered to Industry and to Government departments in the supply of a vast assortment of cables for lighting and power, copper winding wires and strips for electrical motors and transformes, trolley wire for tramway systems etc. As a guarantee of their quality the Company's products are made and tested to the exacting specifications of the British Standards Institution, and will also conform to the new Indian Standards now being evolved.

The Reinforced Concrete Sleepers of the Vagneux System

By Paul Maille,
Graduated from the Polytechnical School, President and Head Manager of the SATEBA

THE use of reinforced concrete sleepers increasingly goes on finding new adepts among the authorities in the field of railway technics. The SOCIETE ANONYME DE TRAVERSES EN BETON ARME SYSTEM VAGNEUX cannot help feeling a certain pride when seeing that the ideas that its founder, Mr. Edmond VAGNEUX, untirely has put forward and defended since 1914, have made their way and are now adopted in France as well as in other countries.

In fact, no experiment with reinforced concrete sleepers had ever been really successful, no one had led to a real utilization on a large scale, before the task was taken up by Mr. Edmond VAGNEUX, chief engineer of the department of "Highways and Bridges", later chief engineer of the French Railroads, creator of the system of reinforced concrete sleepers bearing his name.

The penury of wooden sleepers after the world war 1914/1918 had shown with acuteness that it was to the interest of the Railway Companies to multiply their sources of supply of sleepers and to guard against the uncertainties of the wood market by appealing to the

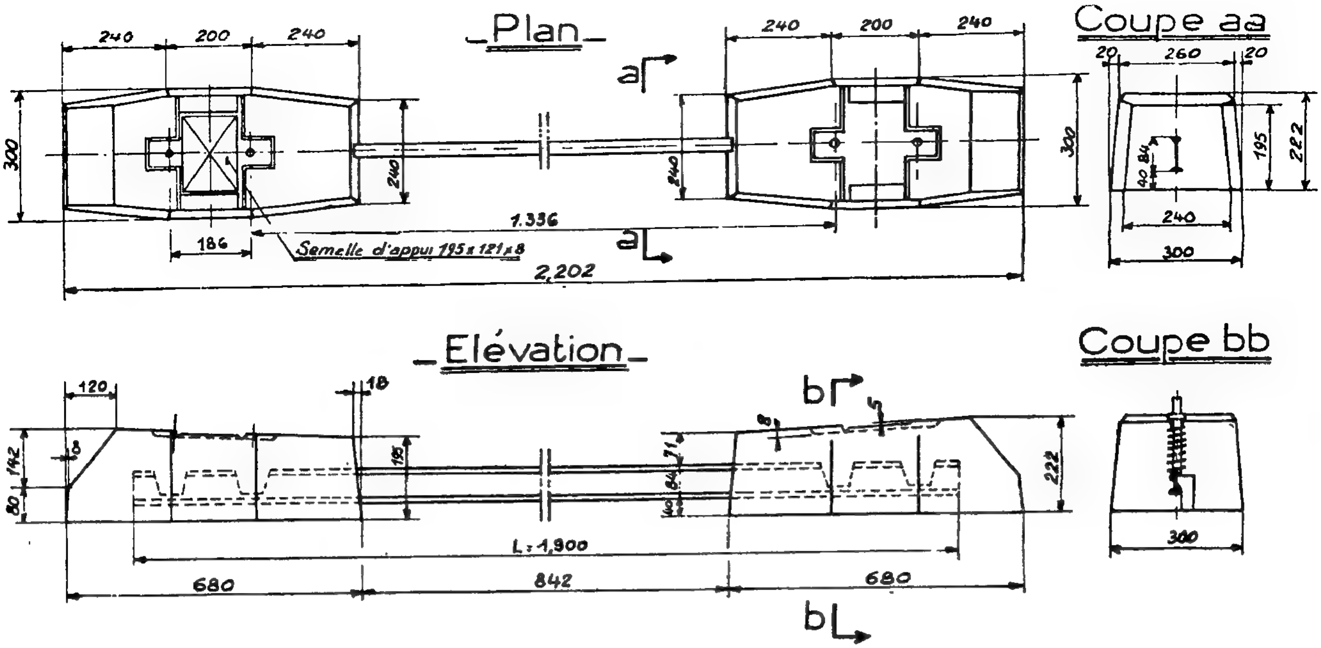


Fig. 1

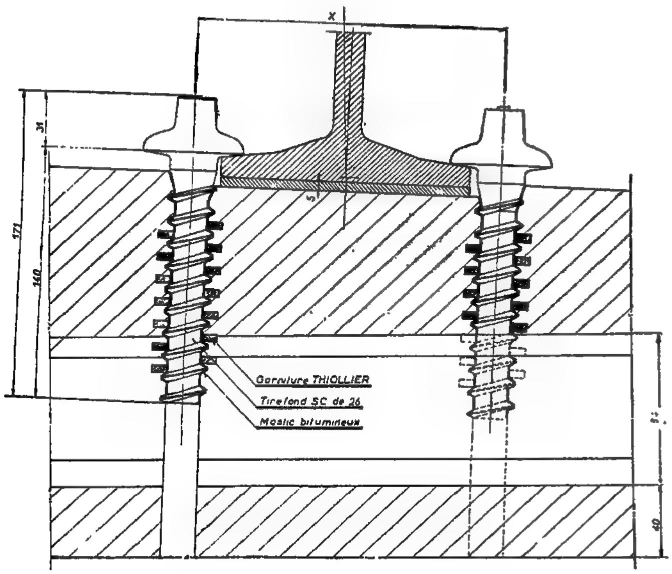


Fig. 2

reinforced concrete. Among the many sleepers that appeared at that time, only the reinforced concrete sleeper of the Vagneux system is still in use, and with success, now for more than 30 years without interruption.

The reinforced concrete sleeper of the VAGNEUX system is well known. It is a composite sleeper, made up of two blocks of reinforced concrete united by a metal cross-beam, either steel beam I section, or a piece of an old rail, or even an old rail relaminated.

Moreover, in 1954 the SOCIETE DE TRAVERSES EN BETON ARME SYSTEM VAGNEUX has taken out a patent for a sleeper of the same type, but with axial fastening device.

This sleeper (Fig. 1.), like the reinforced concrete sleeper of the VAGNEUX system manufactured since the beginning, is built up by means of a metallic cross-beam uniting two blocks or sleeper heads, of reinforced concrete. However, in this sleeper with axial fastenings the cross-beam is a laminated iron with a special bulbous cross-section instead of the beam I PN 80/42.

Besides, the fastenings are situated in the longitudinal axis of the sleeper, two fastenings on each head, placed on each side of the rail.

Like all the VAGNEUX sleepers, these sleepers with axial fastenings can receive any one of the three types of fastening most commonly used at present by the French National Railroads for the equipment of the reinforced concrete sleepers of the Vagneux system, the prestressed concrete sleepers and the longitudinal stringers which they utilize:

(a) Fastening consisting of a coach-screw SC, coated with the special Maille putty and screwed into the Thiollier fitting forming nut (Fig. II).

This is the most simple and the most economical fastening device.

The fastening is perfectly adapted to tracks with heavy traffic but with moderate speed.

(b) Fastening by means of Vagneux bolt coach-screw and rigid clip, with sole-plate of bakelized wood or metal sole-plate (Fig. III). The Vagneux bolt coach-screw is coated with special putty and screwed into the Thiollier fittings forming nut.

Fig. 3

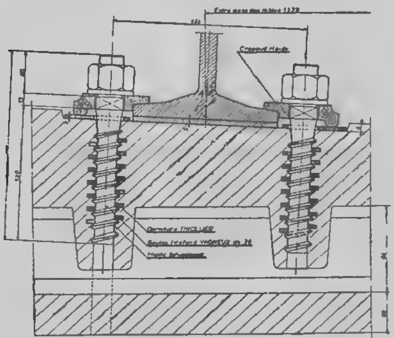
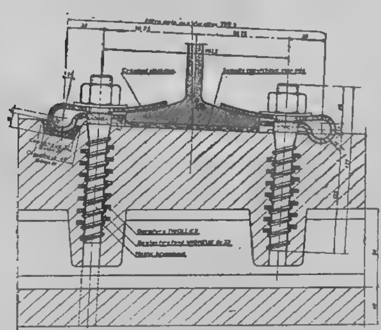


Fig. 4



The combination of different types of clips permits the realization of various gauges with sleepers of the same drilling (between axises of the fastening holes).

(c) Fastening by means of Vagneux bolt coach-screw and elastic clip, with sole-plate of grooved rubber. (Fig. IV).

The Vagneux bolt coach-screw is coated with a special putty and screwed into the Thiollier fitting forming nut.

These two types of fastening, (b) and (c), are used on modern tracks with heavy and rapid traffic.

The type (c) is particularly suitable to the realisation of tracks with rails welded together forming lengths of more than 900 meters, which is the latest development in the railway technique.

As have been seen above, thanks to the various combinations which are possible with regard to the fastening of the rail, the VAGNEUX reinforced concrete sleeper can be adapted to the track to which it is destined according to the traffic conditions on the line in question.

Thus the Vagneux sleepers are to be found on lines with heavy and rapid traffic (passengers and goods) as well as on lines with slow traffic, as industrial junctions, or on tracks with very heavy traffic as harbour lines, coal mines, etc.

The two latter types of track supporting a relatively slow traffic can also be equipped with pairs of blocks not united with a metal cross-beam, alternating with ordinary sleepers. This reduces considerably the cost price of the track in question.

The Vagneux sleeper is thus characterized by this suppleness in adaption to the traffic conditions that the track has to ensure.

(Continued on page 18)

The Role of BICC in Railway Electrification

THE initials BICC, familiar in every continent of the world, are frequently to be seen in those countries where schemes for industrial development and modernisation are progressing most rapidly. It is not possible to compute the many thousands of miles of telephone and power cables that have been manufactured and installed since the first branches of the Group were formed in 1882 nor would any useful purpose be served in enumerating the many overhead transmission line and trolley bus schemes successfully carried out. It is, however, not without review the part played by this Organisation in the modernisation of railway transport systems which has now become an essential feature of our economic life.

British Insulated Callender's Cables Limited, together with its subsidiary British Insulated Callender's Construction Company Limited, has been associated with railway electrification for forty three years, since the commencement of the electrification of the Melbourne suburban lines of the Victoria State Railways in 1912. This scheme was authorised to enable the railway company to cope with the ever growing traffic resulting from the rapidly increasing population of Melbourne during the years immediately preceeding the first World War. Since those early days many further railway electrification schemes have been successfully undertaken and commissioned in countries with climates varying from the sub-trophical conditions of Brazil, South Africa and India, through the more temperate weathers of Australia and Britain to the continental extremes of Poland. The underlying reasons which prompted the several authorities to pursue such progressive schemes were, of course, not identical in each case, although many of the benefits which are inherently derived from electrification were common to all. It may perhaps be advantageous to pause here and outline briefly why this should be so.

All countries for their transport systems required a prime source of power whether it be coal, oil or water and it is a fundamental measure of economy that where one or other of these sources of supply is non-existent or unduly expensive that emphasis should be placed on the full utilisation of the home produced or cheaper product. Certain countries, notably India, Central Africa, New Zealand and others in Europe and Scandinavia are fortunate in possessing

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(*Continued from page 17*)

To sum up, in addition to the qualities of resistance proved by the wide use of the Vagneux reinforced concrete sleeper made by the French National Railway Society (more than 2,500,000 sleepers in service, some of them since 1930 and still satisfactory), the following particularly interesting advantages are to be mentioned:

- Suppleness in adaption to the traffic conditions.
- Possibility of equipping without difference with any one of the three principal types of fastening used at present:
  (1) ordinary coach-screw,
  (2) Vagneux bolt coach-screw with rigid clip,
  (3) Vagneux bolt coach-screw with elastic clip.
- A very reduced maintenance requiring only a minimum of labour.
- Absolute resistance against atmospheric agents, and against parasites, termites, etc.
- Possibility of manufacturing on the spot, either in an important centre or on a movable working place near the place of utilisation. The simple conception of the Vagneux sleeper permits a fabrication that needs only a small proportion of highly skilled labour thanks to the use of a material containing all the latest improvements, manufactured by the SOCIETE DE TRAVERSES EN BETON ARME SYSTEM VAGNEUX in their own factory at Persan (Seine & Oise), France.

At the present time, when great efforts are made, or are going to be made, in the railway service in all countries, either in renovating or in completing the public or private lines it is of importance to lay a great stress upon the advantages offered by the VAGNEUX sleeper, by far the most economical sleeper, because the best adaptable to the various subjections of the traffic and because it has the most important references.

These considerations have not escaped from the attention of the technicians and railway owners who are studying the development and the modernisation of the substructure of their railway system basing their calculations on the use of reinforced concrete sleepers of the VAGNEUX system.

huge latent reserves of water power and it is therefore proper that these peoples should seek to derive the maximum benefit from the natural resources within their boundaries. For such reasons hydro-electric power stations have been planned and built to generate electricity to supply the industrial areas while at the same time the adoption of electric traction is projected in many cases to make use this readily available power.

It is also without dispute that the energy to be derived from coal or other indigenous fuels can be extracted through the medium of thermal power stations and converted to electrical energy with far greater efficiency than can be obtained by burning these fuels in steam locomotives. In addition, lower grades of fuel are normally consumed at power stations in contrast to the high quality coal required for steam traction.

Thus it may be said that conversion to electric traffic effects a considerable saving in the annual amount of fuel consumed. The efficiency of transmission and utilisation at the traction motors is extremely high, and the nature of the power demand at industrial off-peak hours enables the available generating plant to operate at a more uniform and therefore more economical loading.

Erecting the bridge of a multi-track anchor structure—London to Shenfield Electrification.

Four-track, broad flange beam portal structure. Showing a method of "registering" (i. e. locating) the contact wire and auxiliary catenary wire over each track. The wires are arranged in compound catenary form.—London to Shenfield Electrification.

From the operating viewpoint railway electrification provides advantages of similar magnitude. The availability of electric locomotives is very high because power is immediately on hand without the delays imposed by refuelling or refiring. Existing services may thus be operated with fewer locomotives, requiring a smaller maintenance staff together with the complete abolition of fuel storage facilities and turntables, leading to the simplification of sidings. Electrically propelled rolling stock has high rates of

Two-track construction on the Central Railway (ex G. I. P. Railway, India).

Long span lattice structures on the Western Railway (ex B. B. & C. I. Railway), India showing the structure extensions to carry transmission lines. The wires are arranged in simple catenary form.

duplication is thereby eliminated.

In the absence of smoke and soot associated with steam locomotives, the travelling public is presented with clean, fast and attractive rail transport which is unfailingly reflected in increased passenger traffic typified by two recent suburban schemes carried out by BICC in Britain. Today after 5 years of electric operation, the traffic on the London to Shenfield line is more than 100% higher than prior to electrification. On the Manchester-Glossop service after only 8 months, passenger traffic has increased by 142%.

Railway Electrification schemes are of necessity complex operations involving close co-operation between the several railway departments and contracting engineers to ensure the smooth flow of materials and an uninterrupted erection programme. It is at this stage that the wide manufacturing interests of the BICC Organisation and unrivalled skill of the construction staff offer to the railway the maximum advantage.

A detailed track survey must first be made to determine the types of foundation to be employed and siting of structures, places of electrical feeding and sectioning to mention but a little of information that must be carefully compiled. It is sometimes necessary to supplement existing track plans by aerial photography of sections of the route. With this knowledge to hand the structures which are to support

acceleration and deceleration permitting more punctual running and closer timings which enable (heavier and) more frequent trains to be handled over the existing tracks on faster schedules. Costly track

Single track cantilever construction with steel and pre-stressed concrete structures. 6600 Volt alternating current electrification.—Lancaster to Morecambe & Heysham Railway.

or anchor the overhead contact systems are carefully designed while a parallel examination is made of the relevant electrical data including the power to be supplied over each section of the route, permissible voltage drop and the provision of protective devices. Particular attention is required at tunnels, stations and at road crossings where adequate electrical clearances are generally more difficult to obtain.

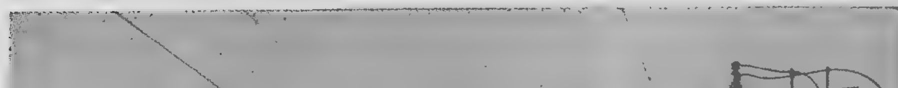
Operations on site begin with the selection of a suitable centre from which the field operations can be supervised and the necessary office and stores accommodation set up. From this depot foundation and steelwork trains convey the material to each track location at which experienced engineers control the excation and placing of the foundations and the subsequent erection of the structures which are usually of steel in one of the many sections-channels, rods, broad flanged beams, rolled steel joists etc. When it is recalled that structures are sometimes required to span eight or more tracks it will be readily appreciated that any small errors in the placing of foundations may prove extremely costly during the steelwork erection. Here, too, close liaison with the railway operating department is vitally important to prevent delay to normal traffic; reference to some of the accompanying photographs will illustrate these remarks.

In due course, other construction trains, from which the overhead conductors are erected, begin operations under the surveillance of the wiring engineers. The conductors will usually be composed of one or two stranded wires per track which are suspended by insulators from the track structures in what is generally known as compound or simple catenary construction (See photographs). These wires form a flexible suspension system to carry the solid copper contact wire. Flexibility is essential to ensure sparkless current collection by the locomotive pantograph which must remain in sliding contact with the contact wire. For the same reason it is essential to avoid sharp changes of gradient of the contact wire during the planning stage and as these changes may also be self-introduced by seasonal changes in the conductor tensions it is sometimes desirable to arrange automatic tensioning devices (see photograph) whereby a constant mechanical tension may be maintained in the conductors throughout the complete temperature range.

Other site work includes the provision of feeder cables and switches by which the catenary system is energised from adjacent traction substations. These substations are frequently interconnected by overhead transmission lines are power cables and may be remotely controlled from a central supervisory centre

Erecting the contact wire using specially modified flat roofed coaches.—Manchester to Sheffield & Wath Electrification.

Adjusting the overhead equipment at the entrance to the New Woodhead Tunnel. Manchester to Sheffield & Wath Electrification.



Electrical sectioning point outside locomotive shed showing switches and feeder cables mounted on the structure.—Manchester to Sheffield & Wath Electrification.

for which purpose telecommunication cables are required. Special auxiliary power cables are also provided for the remote operation of signal and point motors. The joints between the ends of rails are usually electrically bonded to provide a conducting path for the return current and for safety reasons structure to rail bonds are fitted or else a continuous earthwire is used to connect all structures. These and numerous other essential features of a completed electrification scheme cannot be more than briefly described in an article of this length but it is hoped that the details mentioned will serve to enable the reader to appreciate more fully the overwhelming advantages of careful planning in design, manufacture, supply and erection which are made possible by many years of experience in this specialised field.

As recorded earlier the first complete railway electrification scheme pioneered by the BICC Group was in Australia where in addition to the conversion of 341 track miles to electric operation BICC also supplied 20,000 volts transmission mains linking the various traction substations to the Central Power House and telephone cables laid along the same route. In 1922 on behalf of South African Railways electrification of 300 track miles on the Natal Main Line between Pietermaritzburg and Glencoe was undertaken. This section was the most difficult to negotiate by

Lattice-type supporting structure at Thana, Central Railway, India. Note the bird guards over the insulators to prevent accidental earthing of the overhead equipment.

steam traffic, as the route passes through the mountainous parts of the South African Tableland. It is also the main artery between the Natal Coalfields and the coast at Durban where there is a constantly increasing demand for bunker coal. Since electrification the daily gross tonnage hauled in the Glencoe-Durban direction has increased from 13,000 tons to 34,000 tons and the average travelling time in the reverse direction for passenger traffic has improved from 14½ hours to 8 hours. On this scheme which was completed in thirtynine months some 1,000 miles of copper conductors and 7,000 tons of steel structures were used.

Electrification schemes in India commenced in 1923 with the Bombay Harbour Branch and local lines from Bombay to Thana comprising 160 track miles of equipment. This was followed by an extension from Thana to Kalyan and later extensions from Kalyan north eastwards to Igatpuri, and south eastwards to Poona with storage yards and goods sidings. Both these routes include a mountainous section and the equipments for the heavy gradients, tunnels and other special features demanded particular attention. In all 591 track miles of overhead equipment were erected together with 2.2 kV signal supply and 22 kV power supply lines. On the Kalyan to Poona section it was possible as a result of electrification to increase the gradient and remove the reversing station on the Bhore Ghat and so obtain through running. Smoke and fumes in tunnels which had been a source of great nuisance to the passengers were eliminated and considerable increases in train mileages and passenger traffic were obtained (e. g. the annual passenger traffic increased from 33 to 130 millions between 1929 and 1949).

Simultaneously the 52 track miles of the main line between Bombay and Borivli were electrified. The reasons for this electrification, which has since been extended to Vihar, was the necessity for providing a quick means of transport for the growing population ; recent figures indicate that the number of suburban passengers rose from 42 million in 1938 to nearly 135 million in 1948.

In 1934, 163 track miles of the Warsaw suburban system, Polish State Railways, were electrified. This scheme was notable in view of the wide temperature range and ice loading conditions under which the overhead equipment had to operate. For this reason the catenary and contact wires were automatically tensioned using balance weights and supported on swinging canti-lever structures.

BICC has undertaken two major schemes in Brazil where a total of 380 track miles of the Estrada de Ferro Central and the Estrada de Ferro Santos a Jundiai were electrified. The former, officially opened in 1938, served the densely populated area of Rio de Janeiro where electrification was adopted to increase the carrying capacity of the line to deal with the rapidly increasing passenger traffic. The development of hydro-electric power in Brazil combined

The overhead equipment at Mooca levelcrossing showing the arrangement designed to permit tramcars to operate across the electrified tracks. The central section containing the actual points of crossing of the overhead wires is electrically separated from both tramway and railway equipments but may be energised at 600 volts or 3000 volts according to whether the crossing is open to tramcars or trains.– E.F.S.J. Railway, Brazil.

with the scarcity of local fuel supplies and the high cost of imported fuel naturally led to the conversion from steam to electricity as the motive power in the latter case. This scheme from Jundiai to Maua runs through the richest coffee growing area in the world and serves the heavy suburban traffic around Sao Paulo. A rather unusual problem was presented by a tramway crossing at Mooca. Here a system was devised to enable inter-running of both railway and tramway services on the overhead equipment at the crossing, whereby the contact wires were energised at 3,000 volts or 600 volts according to whether the crossing was open to trains or tram cars. A photograph of this equipment is included with the illustrations. As part of both railway projects high voltage power lines and low voltage signal feeder lines were also supplied and erected on extensions to the track structures.

In Britain there are many miles of electrified railway using the third rail conductor principle. This has many disadvantages including limitation of conductor voltage, faults in bad weather and obstruction to track maintenance. Three exhaustive reports in the past twenty years have concluded that the most suitable and economical method of electrification for this country is the overhead catenary system and this form of construction is to be adopted for all major schemes in the future.

Between 1929 and 1931 BICC converted the Manchester-Altrincham suburban line to electric operation. This line, which was the first in the country to be electrified using the 1500 volt overhead system, included a 1⅜ mile section carried on a viaduct with curves and a gradient of 1 in 100.

In 1938 work commenced on the electrification of the London to Shenfield and the Manchester to Sheffield and Wath Lines. Work was stopped during the war years but both routes are now operating electrically and the former scheme is being extended to Southend and Chelmsford. Reference to the great increases in passenger traffic resulting from these schemes has already been made but perhaps even more remarkable are the freight results achieved on the Manchester-Sheffield-Wath project where the haulage of heavy mineral traffic over the Pennine Mountains has been so speeded up that the running time in some cases has been more than halved. On the formidable 1 in 40 gradients of the Wath bank to electric locomotive now haul heavier loads at double the speed of the four steam locomotives previously used while locomotives on the downhill journey with empty stock return power to the line by regenerative braking. Work is now proceeding on the electrification of the main lines between Sydney and Lithgow in New South Wales, Australia. This project across the Blue Mountains, reaching a height of 3700 ft., comprises 240 track miles and the first section has recently been put into service.

We have seen how the cleanliness and speed of electric travel is appreciated by the general public and railway staff alike, while the overall saving and economy in fuel made possible are points of national importance. The Weir Report of 1931 gave the conclusion that in Britain alone the electrification of all main lines would result in a reduction in coal consumption by 72% and in the cost of locomotive maintenance by 57%. Such trends are not unique but have been the experience wherever existing lines have been electrified.

BICC, the largest single organisation in the world with facilities for the design, manufacture, supply and installation of material for the complete overhead system, is proud to have been associated with the many schemes outlined herein. Its resources include well equipped factories backed by first class research facilities and a field force of widely experienced engineers. The Group is foremost in the field of new developments including the provision for British Railways of overhead equipment for an experimental high voltage section using alternating current at the industrial frequency. In addition experimental sites have been built where the characteristics of various forms of overhead construction are continuously recorded by instruments and conductor endurance and foundation tests are carried out.

The results of these and many other similar investigations will be taken into account in BICC's designs for the future and will enable the Group to maintain and improve its reputation for high quality equipment which meets the requirements of Railway Engineers in every land.

BRITISH RAILWAYS ELECTRIFICATION

The British Transport Commission have awarded to British Insulated Callender's Cables Ltd. and British Insulated Callender's Construction Company Ltd. three contracts valued at approximately £5,000,000 for the supply and installation of overhead equipment for about 415 miles of track. The routes are:

Fenchurch Street (London) to Tilbury, Southend and

Shoeburyness — about 170 track miles;

Liverpool Street (London) to Enfield, Chingford, Hertford and Bishop's Stortford — about 105 track miles;

Crewe to Liverpool — about 140 track miles.

The equipment, suitable for operation with 25kV single-phase 50 cycles A. C., includes the foundations, steel structures, and overhead wiring. Survey work on all these schemes has already been started.

The BICC Group has been working for some time on the British Railways pilot schemes between Colchester, Clacton and Walton and on the Manchester — Crewe Line. Installation of foundations and structures started in March 1957, running-out of conductors commenced in October 1957, and the first trial trains should be using sections of equipment during 1958. Staff and plant engaged on the pilot schemes will be employed on the new work, all of which is being controlled from site offices at Crewe and Shenfield (Essex) respectively.

Current will be collected from 0.166 square inch cadmium-copper contact wire suspended from 0.101 square inch catenaries made up of 19 strands of .083 inch diameter cadmium copper.

An extensive research and testing programme has been undertaken to determine the most suitable types of insulators for supporting the catenary wire on the steel structures. On double tracks the conductors will be supported by copper-clad steel cantilevers attached to, and insulated from, galvanized steel masts at the sides of the track.

For more than two tracks a new type of portal structure has been designed to avoid obstruction to the sighting of signals, to reduce weight and to give a good appearance. It is constructed with angles as the main members and with rod bracing welded to the toes of the angles. The structures are completely galvanized after fabrication.

The three new contracts will require about 11,000 tons of steel.

New types of plant for rapid excavation of foundations, erection of masts and concreting have been developed by engineers of the BICC Group, who have over 40 years of experience of railway electrification in all parts of the World.

STANVAC TANKER BRINGS FOODGRAINS TO INDIA

Instead of carrying the usual cargo of crude oil or finished petroleum products, a Stanvac tanker berthed at the docks in Bombay loaded with urgently needed foodgrains for India.

The tanker, "STANVAC MELBOURNE", wrote a new chapter in the history of the Stanvac fleet by taking 560,000 bushels of wheat 8,000 nautical miles from Quebec to Bombay.

The cargo of wheat weighing 15,000 tons which was purchased under the Colombo Plan, constituted one of the most unusual cargoes ever carried under the Stanvac house flag.

The "STANVAC MELBOURNE" under the command of Capt. Norman Halliday picked up the cargo at the St. Lawrence river port of Three Rivers in Quebec Province, Canada.

Enroute from Houston, Texas (U.S.A.), to Three Rivers, the crew prepared her 26 tanks to receive the grain. This involved a thorough cleaning with a special detergent and hot salt water, under the direction of the charterer's expert taken aboard at Houston. The tanks were carefully swept, cleaned and dried to meet the standards of the Port Warden of Three Rivers.

Loading proceeded from grain elevators at a rate of 350 tons per hour (compared to 450/500 tons for regular grain carriers) and the tanker departed for Bombay on December 8.

Incidentally, the grain cargo carried by the "STANVAC MELBOURNE" is the largest ever shipped from Three Rivers, in any type of vessel.

The unloading of wheat in Bombay will be done with vacuator machines, including two loaded at Three Rivers. They suck the wheat from the holds on the same principle as a vacuum cleaner.

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GEN. KIRPAL VISITS ARMY OFFICERS AT PETROLEUM TRAINING COURSE

Major-General P. N. Kirpal, General Officer Commanding, Bombay Area, paid a visit to Indian Army Officers undergoing the Long Petroleum Installation Course in Bombay.

Organized by Standard-Vacuum Oil Company, the Course is being attended by six Officers from all over India.

General Kirpal visited the Stanvac Marketing Headquarters building here, the venue of the training sessions.

This is the third training Course conducted by Standard-Vacuum for Army Officers. During the present 16-week training programme, which will be completed at the end of February, Officers will be orientated to all aspects of the petroleum industry.

The extensive ground covered by the Course can be gauged by the fact that the instruction includes all phases of terminal operation, tank construction, laying of pipelines, pumping equipment, quality control, field storage, product receiving, tanker discharge, waterway distribution, and rail and road distribution.

In addition, specialists are giving lectures on basic refining, geology and drilling, petroleum engineering, blending of oils, construction of ocean-going tankers, fire fighting and even labour welfare.

The training programme set up by Stanvac includes lectures and demonstrations at the Stanvac Marketing Headquarters, the Stanvac Bombay Refinery and Oil Terminals. Arrangements have also been made for the Officers to visit many other important factories. They will see the Atomic Energy Establishment at Trombay and the new Marine Terminal at Butcher Island.

The six Officers from all over India who are attending the Course include five from the Army Service Corps and one from the Engineers. They are: Maj. D. K. N. Soni, ASC; Major K. A. Callender, ASC; Capt. V. P. Singhal, ASC; Capt. S. John, ASC; Capt. John Koshy, ASC; and Capt. R. S. Chaudhri, Engineers.

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A. E. I. in India's Development Projects

By H. C. Hardy, M.I.A.E.E., A.M.I.E.E.

AMONG the basic requirements of economic development, the generation and distribution of electrical power has benefited from the contribution made by the A. E. I. organisation, backed by the considerable technical resources of the constituent companies.

From the beginning of development in India of high voltage technique, A. E. I. have studied the suitability of the plant supplied by them for the onerous climatic conditions to be met in India and in many instances, details of design incorporated in the electrical apparatus have been influenced by the Indian operating requirements.

In addition to supplying equipment, consulting services have been rendered in the case of many projects, particularly in the early stages of development. Such services comprise electrical system studies, load surveys and design of complete electrical projects. The aggregate capacities of the more important types of equipment so far supplied to, or on order from the different electricity undertakings illustrate the part played by this Company in furthering electrical development in India.

Waterwheel generators of an aggregate capacity exceeding .8 million KW.

Thermal power plants of about .68 million KW (both State and private owned).

Transformers of over 1 million kVA.

About 500 outdoor oil circuit breakers for voltages 33-kV and above.

The contribution of Messrs. Associated Electrical Industries Manufacturing Co. Private Ltd., is also significant. Many transformers and about 2500 outdoor type gang operated isolating switches for voltages in the range 3.3 kV to 132 kV have been supplied by Associated Electrical Industries Manufacturing Co. for various electrification projects, also large quantities of motors and transformers for industrial use.

In point of fact, whether the gigantic Damodar Valley Project, Bhakra-Nangal in the East Punjab, Hirakud in Orissa, Khaperkheda Thermal Scheme in Madhya Pradesh, Machkund in Andhra, or the modest Duduma Transmission Scheme in Orissa, North Calcutta Rural Electrification Scheme in West Bengal, to mention only a few, there is hardly any electrical scheme included in the first Plan in which this Company did not participate, in one way or other. The following is a very brief account of the association of this Company with some of the many power projects which were included in the first plan.

Of the several hydro-electric projects in which this Company participated, the Hirakud Project in Orissa may be particularly mentioned. Apart from the supply of complete indoor and outdoor switchgear for the power station, comprising British Thomson-Houston power transformers, ranging from 2 to 42 MVA, voltage ratios 132/11-kV, 132/66-kV, 66/11-kV, with an aggregate capacity of 167,000 kVA, large numbers of Metropolitan-Vickers 132 kV and 66 kV oil circuit breakers and A. E. I. M. gang operated, outdoor type, isolating switches, the outdoor switching station as well as the supporting structures were designed by this Company. Erection, testing and commissioning of the plant supplied, under expert supervision, were also undertaken by the Company.

In the field of thermal power, of the many schemes which this Company executed, the first stage of the Khaperkheda Thermal Scheme and the Grid Substations in the state of Madhya Pradesh, deserve mentioning. For the Khaperkheda Power Station, three 10,000 KW steam turbo-alternator sets of M/s. Metropolitan-Vickers manufacture, complete with all auxiliaries and power station switchgear, were supplied by this Company. For the Grid Substations, which were completely engineered by this Company, the equipments supplied include Metropolitan-Vickers power transformers ranging from 500 to 12,500 kVA, voltage ratios 66-kV/11-kV, total kVA 85,000, outdoor and indoor switchgear manufactured by M/s. Ferguson Pailin Ltd.; complete erection, testing and commissioning also being carried out.

There is yet another field, namely, electric traction, with which this Company has been actively engaged since its inception in India. In recognition of the Company's specialised experience in this regard, an order was received for equipments pertaining to the Railway Electrification Project of the Howrah-Burdwan main line and Tarakeshwar branch line. The order comprises of thirty-six complete sets of 3000 volt D. C. traction equipment for 3-car trains, each having one 840 h. p. motor coach and two trailer coaches, six 3000 volt rectifier substations (total capacity 32,000 KW) comprising twelve pumpless, air cooled, steel tank rectifiers, fiftyone D. C. high speed circuit breakers and auxiliary plant, four 3000 volt track sectioning cabins, having a total of twenty-two D. C. high speed circuit breakers and associated equipment.

The equipments are designed to permit a maximum speed of 65 m.p.h. on level track with a fully loaded train and a starting acceleration of 1.2 m. p. h. per second up to 25 m. p. h. Worthy of particular note is the fact that approximately 15 percent of the traction equipment is being manufactured in India. This manufacture is being carried out by Associated Electrical Industries Manufacturing Co. to the designs of Metropolitan-Vickers. This is the first occasion on which electrical traction equipment has been manufactured in India, and represents a substantial and welcome saving in foreign exchange.

The fixed equipment, i. e. rectifiers, transformers, etc. have been manufactured by the British Thomson-Houston Co. and here again the local manufacture of some of the high speed D. C. circuit breaker equipments has been carried out in India.

Among the several electrical projects under the Second Plan, with which the Company is associated, one example is the Bhakra Power Station in East Punjab, for which the Company will shortly be delivering five 100,000 kVA (maximum rating 115,000) water wheel generators, the biggest capacity so far installed in India.

Calcutta Electrification Project

(By Our Engineering Correspondent)

On 14th December 1957, the Eastern Railway commenced their operation on the 3000 Volt D. C. Traction with the running of the first electric train between Howrah and Sherophuli. It could be expected that this service will be extended by about the middle of the coming year till Burdwan through the main line and till Tarakeshwar from Sherophuli. Undoubtedly it is a very promising start with the inauguration of the first electric train in this part of our country, for the scheme for electrifying the lines till Moghalsarai in the north, Kharagpur in the south and also the suburban lines of the Sealdah division has already been finalised. It may well be taken that this scheme will take shape very shortly and the routes electrified in the near future.

Messrs. S. A. E. (India)'s contribution to the first stage electrification scheme has been quite substantial. For this scheme about 180 different types of galvanized track structures had to be designed involving as many as 3038 Nos. of structures, of a total weight of about 7000 tons. They have supplied all these structures in addition to about 800 tons of copper catenary wire, 700 tons of copper contact wire and various fittings and attachments all to electrify about 300 track miles of lines.

The technical aspect of this scheme of track electrification is a matter that has taken quite some time for designing the most advantageous and economical solution. The design and fabrication of materials have been done jointly by S. A. E. (India) and their Italian suppliers who have a contingent of highly qualified and experienced experts and Engineers backed with an experience of over 30 years in this line. The structures are all galvanized, of partly high tensile and partly of normal tested steel. The fabrication has been done in the works of Messrs. Societa Anonima Elettrificazione, S. p. A., Milan, where every month about 10,000 tons of fabricated steel is being produced and much of it exported to many countries of the World including Australia, Canada, the U. S. A., South America, etc. The Overhead Equipment fittings have been supplied partly by M/s. Societa Anonima Elettrificazione, S.p.A., Milan and partly by M/s. Rebosio of Milan. The copper contact wire has been supplied by M/s. Metallurgica Italiana, Firenze, Italy. The Insulators have been supplied by M/s. Industria Ceramica Italiana of Laveno, Italy. The copper catenary has been supplied locally by Messrs. NICCO of Calcutta.

The complete erection of these structures and overhead equipment is being done by specialised staff equipped, organized and trained both in India and Italy whose work has the appreciation and the kindest co-operation of the Departmental Engineers. It would be interesting here to note that they have been able to achieve within the last 2 months a record progress setting up nearly 70 miles of lines inspite of the difficulties faced on account of the monsoon and the heavy traffic running on one of the most congested Railway in the World, where work can be carried out only at night for a very limited number of hours.

NEW DIESEL-ELECTRIC LOCO FOR BRITISH RAILWAYS

The first mixed-traffic Diesel-electric locomotive for British Railways' £1,200 million development scheme — a scheme which is designed to make the system the most up-to-date in the world — was handed over on October 31, five weeks ahead of schedule. This 1,250 hp. locomotive is designed for speeds up to 75 mph. though it is capable of 90 mph.

The remaining 19 locomotives in this batch, now on the assembly line, will roll off at the rate of one every three weeks. They will go into service next year in the Eastern Region of British Railways, hauling both passenger and freight trains.

Under British Railways' development scheme there will be a huge increase in the number of services operated by Diesels; by the end of 1957 alone it is expected that over 1,450 vehicles for use in multiple-unit Diesel trains will be in service. At least 1,000 more will be added by the end of 1958.

HISTORY OF MYSORE LAMPS

By A Correspondent

THE History of ELECTRIC LAMPS dates back to the time of Alwa Edwin Edison (1879). As a result of his repeated Researches he was able to produce the Incandescent Lamps making use of Carbon Filaments achieving a life of about 500 hours. Ever since that time, the Industry has developed with new improvised Techniques making larger production with increased light out-put, all such lamps giving 1000 hours of burning life.

By 1911 Lamps were produced with Tantalum Filament and later by 1912 drawn Tungsten Wire came into use as a filamentary body. It was the endeavour of the Lamp Engineers to search for a material of a very high melting point so that they could raise the operating temperatures to the filaments. The success was achieved by 1914 and the modern gas-filled lamps came into vogue. The straight wire that was originally used was coiled into a helix and subsequently to a double helix which is commonly called as Coiled Coil. Further Researches are taking place in the advanced countries to make Coiled Coiled Coil. This is yet to come to production in our country. Thus, we see the History of the Electric Lamps is the History of the evolution of the technique of vacuum and starting from Carbon Filaments they have reached Tungsten Wire Filaments passing through the stages of Osnium and Tantalum.

The principle of Electric Lamp is fairly simple. With the electric current passing through a metallic wire it results in heating and the matter is raised to incandescence. It is this light out-put which a Lamp Engineer attempts to conserve to simply increasing the efficiency of the lamps, other qualities being equal. It is therefore apparent that the high melting point of Tungsten (3400 Deg. C) has a very important advantage in the economic production of light. Though Tungsten is ideally suited as a filamentary body, the technique of drawing the material into a thin wire involves the entire

engineering skill at command. The Wolfram Ore is crushed and brought to a powder form. This powder is pressed into a small bricket and these brickets are pressed into bars (10×10 mm. Square) and from 8×24″ in length. The strength of the bar is increased by heating it in hydrogen. These bars are further subjected to a treatment known as "Sintering". The sintered bars are further subjected to a process "Swaging" where very rapidly rotating hammers around the axis of the tungsten rod convert tungsten into thick wires. These thick wires are passed through Diamond Dies through special lubrications to various required sizes and these are called drawn tungsten wire. Tungsten while it is yet in powder form it is customary to add certain Oxides so that the growth of the crystals can be controlled to maintain the luminosity. It is at this stage various grades of wire are developed meant for various types of lamps depending upon the efficiency of the lamp required.

Simultaneously the tungsten filaments a special wire was devised so that it could be pinched into a glass making it vacuum tight. Such an economical alloy is "Dument". This revolutionise in working out the cost of the Lamp production.

It was found that if the filament inside the lamp was subjected to an increased pressure it could be operated to a higher temperature for the same wattage and in consequence the Gas-filled lamps were developed. The straight wire that was used in the vacuum lamp had to be re-designed into a single coil or coiled coil as the case may be to minimise the loss of heat by way of convection when it was surrounded by gas pressure inside the lamp. Needless to mention that the gas must be inert in view of the high temperature of the filament inside the lamp. Hence, normally Argon and Nitrogen are the chief Gases required in this Industry. Sometimes, "Helium" and "Xenon" Gases are also used to get higher efficiency lamps in special cases. Each of these inert gases in various proportions at various pressures inside the lamp exhibit special characteristics in luminosity and every Factory has its own special proportions. Inspite of such improvised techniques in Lamp Engineering, it may appear strange that in a 100 W. Incandescent Lamp, the Lamp Engineer has utilised about 12% of the input energy while 88% is converted into heat and removed from the lamp by radiation, by evacuation and by conduction.

In view of the Tungsten being at a high temperature within the lamp and also its sensitiveness for reaction of the moisture it is absolutely necessary that the inside of the lamp must be moisture dry. The reaction is very sensitive and the presence of moisture will result in rapid evaporation of the lamp and consequently very early blackening. It is for this reason in the Lamp World, moisture is said to be the enemy of the Electric Lamp during production. It is said that one drop of moisture may spoil 50,000 lamps if the system is not free from it.

PRODUCTION: The first stage during manufacture is Stem Making. The two Electrodes, the evacuating glass tube, the flare and the cane are alligned properly and they pass through a process wherein a vacuum is made at the Dument. At this stage a small bore is made at the pinch to facilitate evacuation at the Exhaust. These stems are passed on to the Anchoring Machines where a small button is made at the tip of the cane and the Molybdenum Wire is inserted. It is very interesting that small lengths are cut and at the end of each the pit-tail hooks are made at a fairly fast rate at the automatic machines. These Machines are designed to accommodate from 1 to 24 supports, depending upon the type of the lamp. These anchored stems pass on to the Mounting Mill where the filaments are automatically picked up, clamped and mounted. Generally such mounting mill is very costly and hence it is the normal practice to use leg-operated mechanical Clampers engaging more Operators. This is typically suited for our Indian conditions, where unemployment is a problem in our country. Moreover, even for lesser labour we are fortunate to get more intelligent and skilled labour in our Country. For this delicate process Girls are specially suited.

The mounted stem passes on to the Sealing Machine wherein in Bulbs are sealed to the Flare and the extra cullet is automatically removed and the sealed bulb passes on to the Vacuum Pumps. At this stage of Exhausting, the Lamp passes through a heating temperature and simultaneously suction is going on. In this process all the gases from the glass walls are released and pumped out. After a sufficient high degree of vacuum is attained, the inert gases are filled in and finally the exhaust tube is sealed off automatically. Now the lamp is ready to receive the Brass Cap. This is the finishing stage where the Brass Cap with a thin ribbon of the bakelite cement at the neck will be fitted and subjected to baking.

This will result in glass to melt still and finally they are soldered at the eye-let and outside. It is the commercial practice to give a coating of Red Phosphorous on the filament itself before it is sealed.

After finishing of the lamp, the lamp is lighted up in very low voltages, so that the phosphorous may get pulcerated into small highly reactive particles and as a result electrically charged. In such a condition, the highly reactive phosphorous will absorb the extraneous matter within the lamp. This process being a surface absorption is called as " Absorption ". This pressure comes from high vacuum and the process is called " Flash Ageing ".

The Day's production undergo systematic check-up at regular intervals at the Photometry. These lamps at present are being designed for the British Standard Specification, the normal average life being 1000 hours. It is important that every process during manufacture must be rigorously controlled and inspected. Periodically sub-standards are got from the authorised Testing Laboratories so that the production is standardised for its uniformity and high quality.

Though there are more than 10 Major Factories in India and a few small Factories manufacturing the Electric Lamps, in South India the Mysore Lamp Works is the only one of its kind. It has a modern Automatic Plant for the production of General Service Lamps and also they have added a few more Machines to manufacture Miniature Lamps like Bicycle, Torch and Automobile Lamps. At present they are manufacturing Lamps from 15 Watts to 1500 Watts which is the maximum in the B. S. S. as far as General Service Lamps are concerned. A Personnel in the Works has undergone special training under American Experts in production technique.

The Factory was started in 1937 with a production capacity of 2000 lamps per day and now it has an installed capacity of 4.8 million per annum (16,000 lamps per day). It is successfully catering to the needs of the Electrical Departments of Mysore, Hyderabad, Bombay and Madras and also some of the Electrical Corporations in the South. The Lamps are very popular for its quality.

The Sales Organisation has its Distributors throughout India including Kashmir and Nepal. The Mysore Lamps are on the approved rate contract for the Railways and General Service. The Country for the first time is meeting its demand of High Wattage Lamps like 750 W., 1000 W. and 1500 W. Due to their quality, these high wattage lamps enjoy full confidence of the D. G. S. & D. in matters of Rate Contract. It has also met the full demand of lamps like Headlights, Train Lighting Lamps, Coloured Lamps, Cab lights, etc. In addition to these types, Series Type of Street Lighting is a speciality for Mysore Government and Hyderabad Electricity Departments. For a visitor who has seen this Factory in 1937 and who visits in 1957 he will be impressed with the rapid progress made at the Works in increasing the production and also the methods of production control. Simultaneously with the progress of lamp making it is a happy sign there is perfect co-operation between the Management and the Labour in the Day to Day administration. Certain amenities like Canteen, Club Room with facilities for Outdoor and Indoor Games are worth noticing and the activities after the day's labour are thrilling, at the Club. The Sports Club has won many Trophies and Medals in Basket Ball and Ping-Pong.

The relations between labour and the Works are highly democratic and as a result the Management is enjoying full confidence of the labour. In short it is a model Factory in the South with regard to production maintenance and labours relations, with all æsthetic environment at the surrounds. In India, the Annual requirement was 18 million and in 1952 it was 20 million and just now it is 30 millions. By 1961 our Country may have an annual demand of 35 millions and with a little exaggeration it may even be 40 million per annum. Much depends on the development of Hydro-Electric Schemes for generation of electricity and its transmission to the consuming Centres which ultimately results in rural Electrification and also providing adequate number of houses for raising the standard of living in general. With such a programme ahead, there is a bright future for Electric Lamp Industry. Though at present it is unfortunate we have to import most of the raw materials from abroad, serious effort is being made on a planned basis to start making most of the raw materials in our Country. Till then it is difficult to say that this Lamp Industry is self-sufficient in India.

Manufacture of Steel Castings for Locomotives, Carriages and Wagons

*By * N. G. Chakrabarti, A.M.I.P.E., M.I.B.F., M.M.G.I., M.A.E.*

INDIA with all her past glory and tradition was not lacking in the technique of casting metal to shape. At one time she had the privilege of making the finest steels which were widely exported to other parts of the world. The remnants of iron and Steel castings discovered by archæological exploration, such as cannons provide vivid examples of founding technique of the highest calibre. The metallurgical composition of such castings was of uniform consistency and showed excellent workmanship in moulding technique. The famous " Iron Pillar " at Delhi is an outstanding example of the existence of such technique in India. Writing in the Preface of his Book " Stainless and heat resisting Steel ", Dr. Edwin Gragory Prof. of Metallurgy, Sheffield University, made the following remarks " Only at one known point of the world's surface was a notable victory obtained over the inevitable red destroyer at Delhi, where for centuries an iron pillar, 'one of the wonders of the world' stood and still stands, unassailed by time."

With the revival of India's iron and steel industry, at the beginning of 20th century, the steel foundry industry, also expanded rapidly, mainly on account of the expansion of Indian Railways and their demands for castings required for the maintenance of Locomotives, carriages, wagons etc. Since World War 1, about 6 or 7 Commercial steel foundries have been established in the country with potential capacity of about 1,000 tons per month or 12,000 tons per annum. This is very insignificant compared to what is produced in the U. S. A. and the U. K.

From the various technical journals it is gathered that Britain produces nearly 2,38,000 Tons of Steel Castings per year from about 102 steel foundries and U. S. A. 8,00,000 Tons from 300 foundries. Even South Africa's production of Steel Castings has been 45,500 Tons per annum from 17 steel foundries.

India with her extensive Railway communication system covering nearly 44,602 miles of track including sidings and with 2,00,645 wagons, 12,813 carriages and 7,732 Locomotives on the track, has in actual service about 3,30,000 Tons of steel castings. If the renewal of these castings, be assessed at 2% per year the total requirements of steel castings, for the purpose of maintenance alone comes to about 6,600 Tons. On the top of this, there are fresh building programmes which comes to about 6000 wagons 400 carriages, and 220 Locomotives. The demand on this side alone can be assumed to be between 10/11 Thousand Tons per annum. Steel foundry Industry therefore, constitutes a key Industry and is vitally essential if India is to become self-supporting in the manufacture of Railway Rolling Stock etc.

Steel Foundry technique is extremely intricate and requires many years of practical experience, although a good deal of information is available in the metallurgical and Engineering Text Books about melting technique, Foundry Pattern making, moulding, foundry sand and so on. The subject is so vast that it is impossible to do full justice on all the aspects in full detail in a short paper like this. I will therefore touch very briefly on the fundamental principles of Foundry Technique required for the manufacture of railway castings. In India, the manufacture of steel castings for Railways is generally governed by I. R. S. Specification M 2 which states. " The Castings shall be manufactured from steel made by the open hearth, Electric or Acid Bessemer process, and shall not show on analysis more than 0.06 per cent of sulphur or of phosphorous. Castings manufactured from steel made by the Basic Bessemer process will not be accepted. The castings shall be required to pass the tests, specified according to classification and grade. The class of castings and grade required shall be specified on the drawing or in the order." It would be foolish to assume that this is the be all and end all of all the technique required either for the manufacture or Inspection of steel castings. The mysterious trade secrets and craftmenship of a few artisans on different foundry techniques are now generally breaking down and the subject is rapidly becoming an exact science.

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MELTING PRACTICE

Liquid steel is made either by oxidising and refining of pig iron or by remelting and refining of scrap steel. The furnaces used in India for this purpose are Acid or Basic open hearth furnaces, basic electric furnaces and tropenas furnace. For acid open hearth practice, selected raw materials (particularly selected pig iron) i. e. Hematite Iron is used as Dephosphorisation and desulphurisation cannot be effected by this process. For basic open hearth practice 50% basic pig iron with 50% scrap steel are used as raw materials. In the case of the basic electric furnace process which is very widely used in India scrap iron, the cheapest raw material is used for the purpose. Phos. and sulphur content of the steel must be low as red shortness or cold shortness may develop during subsequent heat treatment. The molten metal should be properly killed by addition of ferro-alloys, such as ferro-Manganese, Ferro-Sillicon and Al, etc., as otherwise the castings will be unsound due to formation of blow holes. By whatever method the liquid steel may be produced it is poured into some form of moulds for solidification. If these cast objects are used without any further mechanical working except cleaning and machining such parts are called "Steel Castings".

PATTERN MAKING

The ultimate form of the steel casting depends entirely on the particular size and shape required by the designer. To produce sound casting, the necessity for good and accurate pattern making cannot be over emphasized. The job of making of proper patterns, core-boxes for core making, methods of gating and feeding are very complicated. Standardization of these processes requires long experience with high standard of workmanship. Patterns may be made of metals such as brass, cast iron, Aluminium etc., Timber, Plaster and Plastic-Timber being most commonly used.

While selecting the material for pattern making one must consider the design of casting, number of castings to be made, method of moulding to be employed and the question of overall economy. Shrinkage allowances, finishing allowances and gating and feeding arrangements as provided by the processing drawing, are the vital points to be considered by the pattern makers. Each and every casting has its own peculiar running and feeding problems which are thoroughly studied and standardised. During recent years, this has developed into a highly technical subject and after many years of research and practical tests the following different types of feeding and gating systems developed. The attached table shows the different methods of gating and feeding.

TABLE 1 (B)

Gating & feeding method	Yield%	Type of castings
1. Gravity	40 to 60	Any casting
2. Whirl gate	55 to 65	Casting up to 1 Ton.
3. Atmospheric	60 to 75	Properly designed castings up to 10 Ton can be made by this method.
4. Centrifugal	65 to 85	Circular or symmetrically designed castings may be made by this Process.

FOUNDRY SAND

Foundry sand mixing is another very important factor. Green and dry strength green and dry permeability, refractoriness, grain size and shape, angularity, plasticity and the chemical composition are the properties of foundry sand which should be given utmost consideration. For use in the foundry different sands along with binding materials such as bentonite powder, fulbond or other proprietory bond, molasses, cement, Linseed oil, destrin, resin etc., along with some water or moisture are properly milled to develop the necessary properties and are used for moulding, core making etc.

ANALYSIS OF SAND

	$Si\,O_2$	$Fe_2\,O_3$, $Al_2\,O_3$
Taljuri	90%	8%
Jubbulpore	92%	5%
Yellow Sand	70%	30%

SIEVE SIZE

	8	10	16	22	30	44	60	100
Taljuri			0.6%	10%	28%	37%	13%	6%
Jubbulpore	7%	2.6%	17%	17%	19%	13%	14%	8%

MOULDING TECHNIQUE

Having thus obtained the proper pattern for the desired casting preparations of moulds in sand according to practice are to be considered. The methods of moulding to be employed in case of steel castings are (1) The old orthodox method of dry sand moulding (2) Green sand moulding and (3) Cement moulding. (not practiced yet in India).

In case of Dry sand practice, the mould are baked in drying ovens before core setting and closing.

In case of green sand practice the composition of the moulding sand is such that drying of the moulds is not required. Generally medium railway castings and other medium jobs can be made by green sand method. It is to be noted that for the first time in India, M/S. Bhartia Electric Steel Co., Ltd. have introduced green sand practice with very satisfactory results since 1948. Considerable economics have been effected by the introduction of this method.

The moulds may be made on various types of pneumatic moulding machines such as Jolt squeeze and Turnover type machines, sand slingers, Pneumatic rammers etc. Along with these moulding machines, hand moulding still survives. The standard railway castings are generally carried out in standard Jolt-squeeze turnover type pneumatic machines.

After these moulds are made they are rectified, cores are properly set, closed, runners and riser heads are set in position and then cast into form by liquid steel of desired specification and composition.

FETTLING, ANNEALING, MACHINING ETC.

After these castings are made, the risers and runners etc. are cut off by Oxy-Acetylene gas flame and the castings are properly cleaned from adhering sand by shot blashing, sand blasting, grinding, filing, chisseling etc., rectified by welding if required and sent for proper annealing in annealing furnaces for removing stresses and strains set up during solidification and also for the development of required 'structure' and physical properties. Then these castings are sent to machine shop for proper machining.

INSPECTION

Inspection actually starts from the blue print stage followed by careful checking of patterns, core-boxes, moulds, core setting, checking before and after fettling and before and after machining. While simultaneously carrying out Inspection of important basic raw materials such as scrap steel, Ferro alloys, Chemicals, various types of moulding sand, coal, Lime stone Dolomite etc. along with various machine tools, such as grinding wheels, cutting tools etc. In all Foundries Inspection is such an important factor that it must be carried out vigorously so that castings manufactured from such raw materials satisfy the chemical and physical tests as provided in the specification.

If all the factors such as proper layout of equipments proper methoding, standardisation of patterns and core boxes, coupled with mechanised supply of required sand, supply of molten metal of required specification and temp., skillful work by the workmen at every stage, can be synchronised, founding becomes a good sport and art when success can be very easily obtained and India can be self-sufficient so far as the supply of steel castings required for our entire Railway system is concerned.

INDO-NORWEGIAN TRADE

The validity of the trade agreement between India and Norway, has been extended up to the end of December next. Under the agreement India will continue to export to Norway, inter alia, mica, iron and manganese ores, and light engineering goods. Among the commodities available for export from Norway to India are aluminium manufactures including aluminium boats, galvanised and black steel pipes, testing machines, welding equipment, machine tools and miscellaneous machinery.

A.E.I. Equipment for first 3000 Volt D.C. Railway Electrification in India

By R. Subramanian, B. Sc. (Hons.), D. I. I. Sc.
Associated Electrical Industries (India) Private Ltd.

THE electrification of the Howrah-Burdwan Main Line of the Eastern Railway has the distinction of being the first 3000 volt D.C. Electrification on the Indian Railways. Associated Electrical Industries (India) Private Ltd. are proud of their contribution to this important suburban electrification, which is calculated to bring much-needed facilities to Calcutta's travelling public after a century of steam locomotion. Their role in this scheme includes the supply and erection of substation and track cabin equipment, electric traction equipment for the multiple unit stock and electric signalling equipment. All the equipments incorporate the accumulated experience, aggregating over a century, of the A. E. I. Group of Companies in the design and manufacture of all classes of electrical plant for use all over the world.

The 66-mile Howrah-Burdwan Main Line is equipped with 6 rectifier substations and 3 track cabins, the entire equipment for which, with the exception of the outdoor 33000 volt A.C. Switchgear, has been supplied by A. E. I. This large installation uses pumpless steel tank aircooled rectifiers which have now become well-established for traction service.

The installed capacities and other basic details of these stations are as follows :—

Station	*Installed Capacity*	*No. of Outgoing Feeders*
Belur Substation	3–2500 KW units	10
Sheoraphuli ,,	3–2500 KW units	7
Bandel ,,	2–3000 KW units	6
Pundooah ,,	1–3000 KW unit	4
Memari ,,	1–3000 KW unit	4
Gangpur ,,	2–2500 KW units	8
Howrah Track Cabin	—	11
Konnagar ,, ,,	—	6
Burdwan ,, ,,	—	4

The Substations receive power from the Damodar Valley Corporation system, over the Eastern Railway's transmission lines, at 33000 volts, 3 phase, 50 cycles A. C. It is then transformed and rectified to 3000 volt D. C. by the transformers and rectifiers in the substations. The outgoing D.C. supply to the overhead equipment on the tracks is controlled by 3000 volt D.C. high speed circuit breakers. At the track cabins, similar high speed circuit breakers are provided to sectionalise and parallel the overhead equipments of the various tracks.

The rectifier transformer is of the outdoor, oil-immersed naturally-cooled type and weighs approximately 34 tons. The 33000 volt primary is connected in star, while the 3000 volt secondary is a 12-phase quadruple zig-zag winding. The transformer tank also houses a tertiary winding to provide a 400-volt 3-phase A.C. supply for the rectifier auxiliaries, a no-load voltage rise suppression unit and special current transformers for protection of the rectifier against back-fire.

Each rectifier unit consists of two pumpless, steel tank, air-cooled, six-anode mercury arc rectifiers. The tanks are mounted on withdrawable trucks on wheels, and are housed in steel cubicles. Underneath each tank, and forming part of the truck, is mounted a motor-driven fan to cool the tank. The rectifier cubicle also houses the ignition and excitation unit, grid control apparatus and other auxiliaries for the rectifier. The complete rectifier unit occupies a floor space of only 8 ft. × 5 ft. 6 ins., which has been possible due to the use of a most compact design of rectifier tank so far developed for Railway service.

The rectifier tanks are provided with grids, which are used for arc suppression in the event of a back-fire. Voltage control on the rectifiers is by means of off-load tap-changing switches on the rectifier transformers.

Adjacent to the rectifier cubicles, and forming a continuous panel with them, are the two cubicles which house the control and protective gear for the rectifier and its associated oil circuit breaker. In these cubicles are contained various instruments to measure the voltage, current and power being supplied by the rectifier, switches to start and stop the rectifier, indicating lamps and protective relays.

All the 3000 volt D.C. circuit breakers are of the high speed type, working on the "rate of rise of current" principle, which enables discrimination between overloads and short-circuits. The breakers are mounted on trucks on wheels, which are housed in concrete cells. Shutter mechanisms, with padlocking arrangements, are provided which ensure perfect safety for personnel working inside the cells with the breakers racked out. The rectifier breakers are rated at 1600 amps. and are set to trip on a reverse current of 500 amps. The feeder breakers are rated at 1000 amps. and can be set to trip on forward currents in the range of 1500 to 2500 amps.

The operation of the entire equipment is automatic, and can be controlled either from the control board in the substation or from the supervisory remote control board in Howrah. Operation of one switch will in succession, close the 33000 volt A.C. oil circuit breaker, start the rectifier fans, put on the ignition and excitation circuits in the rectifiers and close the 3000 volt D.C. rectifier high speed circuit breaker. Protective devices ensure that the set is shut down and re-started (for a pre-determined number of time) in the event of any type of fault or incomplete sequence.

A noteworthy feature in the equipment is the comprehensive scheme of interlocking provided. Before access to the rectifier equipment could be obtained, a series of operations in a definite sequence have to be done; this is aimed at isolating the A.C. and D.C. sides of the equipment and earthing all live parts; conversely, these operations in the reverse sequence must be performed before the equipment could be energised.

Other items of equipment inside the substation are an L.T. A.C. / D.C. board, which provides power at 400 volt 3-phase A.C., 110 volt single phase A.C. and 110 volt D.C. for the control circuits and auxiliary services, a negative recording cubicle to record the current drawn from the substation and to provide protection against an excessive rise in voltage of the rails above earth, a lead-acid station battery and a charging equipment.

The entire equipment, with the exception of the batteries and charging equipments which have been supplied by two well-known battery makers, has been designed and manufactured by the British Thomson-Houston Co. Ltd. of England, a member of the A.E.I. Group of companies. A portion of the 3000 volt D.C. switchgear has also been manufactured in India by Associated Electrical Industries Manufacturing Co. Ltd., to BTH designs.

Associated Electrical Industries (India) Private Ltd. have also on order the complete traction equipments for 36 motor coaches and 68 trailer coaches to operate on the Howrah-Burdwan Main Line. These equipments, which will be installed on coaches built by Jessop & Co. Ltd., are being designed and manufactured by Metropolitan-Vickers Electrical Co. Ltd. of England, another member of the A.E.I. Group of Companies. The design of the equipment will be generally similar to the 450 sets of 3000 volt D.C. motor coach equipments successfully manufactured by Metropolitan-Vickers for railways in South Africa, Brazil and Poland.

Each 3-car train will comprise one motor coach and two driving trailer coaches, the motor coach being in the middle. The train will be powered by 4–210 H.P. traction motors, mounted in the motor coach. The motors will be of self-ventilated, axle-hung, nose-suspended type, driving the wheels through solid gear-wheels. Current at 3000 volts D.C. will be collected from the overhead line by either of two light-weight pantographs and fed to the motors through the standard form of resistance control. The motors will be connected permanently in series—pairs, and the control gear will be of the modern electro-pneumatic unit contactor type. A motor-generator set, mounted on the underframe and driven off the 3000 volt D.C. supply, will provide low tension power at 110 volt D.C. for train lighting and ventilation, operation of the control circuits and of the brakes.

The equipments are designed to permit a maximum speed of 65 m.p.h. on level track with a fully loaded train, and a starting acceleration of 1.2 m.p.h. per second up to 25 m.p.h. Upto three 3-car trains can be coupled together and operated by one driver in the leading cab, which facility will be required during peak hours. Provision is also made to cut out half the motor power and run the train at reduced speed, in the event of a fault in any one motor.

Worthy of particular note is the fact that approximately 15% of the traction equipment is being manufactured in India. The manufacture is being carried out by Associated Electrical Industries Manufacturing Co. Ltd., to the designs of Metropolitan-Vickers. This is the first time when manufacture of traction equipment is being carried out in India, and represents a substantial and welcome saving in foreign exchange.

The electrification of the Howrah-Burdwan Main

Line also involves provision of automatic signalling between Howrah and Serampur, and manually controlled colour-light signalling beyond. Well over 350 colour-light signals of the multiunit type, 50 electric point machines, and considerable numbers of junction direction indicators, A. C. and D. C. relays, and other signalling equipment have been supplied by Associated Electrical Industries (India) Private Ltd. These equipments have been designed and manufactured by Metropolitan–Vickers–GRS. Ltd. of England, also a member of the A. E. I. Group of Companies.

PRESSURE ON THE RAILWAYS

Shri M. N. Chakravarti, General Manager of Central Railway, speaking on the subject of "Pressure on the Indian Railways", described the difficult position in which they were placed with an almost crippling shortage of rolling stock, machinery and plan on the one hand and a sharply rising volume of traffic to be carried on the other. Besides, heavy arrears of renewals and replacements of overaged assets awaited clearance.

Discussing the problem of overcrowding in trains he stated that the travelling habits of our people had changed and they had become more travel minded. Against 1¾ journeys per year performed, on the average, per citizen in India in 1940, the figure was now 4. To this must be added the traffic arising from the growth of population over the period of almost two decades. The cumulative result was that against 499 million passengers carried in 1938-39 in the whole of undivided India, we carried 1360 million in our country in 1956–57. To carry this traffic which had increased almost three-fold, the railways of undivided India had 15,500 passenger coaches which fell to 11,000 just after partition and was now just back to what it was for the whole of India in 1938–39. The usage of coaches was 25 per cent better now as coaches were doing longer runs (170 miles per day against 137 pre-war, on the average) with quicker turn rounds. The overcrowding that we would otherwise have had, has been relieved to this extent.

Referring to goods traffic, Shri Chakravarti stated that it grew from 69.8 million tons in 1947–48 to some 126 million tons in 1956–57 i.e., by 81 per cent. Half of this increase had occurred in the last three years of this decade, he said, showing how the rise was not just proportional—the increase was becoming steeper and steeper and by 1960–61 it was expected to rise to 180 million tons, i.e., by 54 million tons in four years against 57 millions in the previous decade. Against this increase of 81 per cent in goods traffic carried, Shri Chakravarti stated, wagons had increased by 20.6% and locomotives by 21.4%.

The higher increase in traffic carried had been the result of more efficient use of rolling stock. Universally adopted indices of efficiency such as the net ton miles of traffic moved per wagon day had shown increases of 60% in the past decade. Locomotives which were averaging 72 miles per day per engine on line in 1947-48 were now averaging 85 miles. After their assessment of the performance of the Indian Railways, the World Bank remarked on the fine job done with the assets at the disposal of the Administration.

Putting right certain misconceptions that existed in some quarters, Shri Chakravarti stated that only Rs. 525 crores out of the total outlay of Rs. 1125 crores on the railways under the Second Plan was for development and expansion. The balance of Rs. 600 crores was being spent on rehabilitation including renewals and replacements of overaged assets, inescapable safety works, Passenger amenities, staff quarters and training programmes which had no bearing on development and would have to go through, plan or no plan. Of this expenditure of only Rs. 525 crores for development, Rs. 183 crores or more than a third would go for rolling stock on additional account.

The current Plan, admittedly, could no more than overtake arrears of replacement and add a little on the development side, he stated. Effective modernisation could not yet be undertaken. The addition to capacity would not be anywhere near the 50% extra goods traffic and 30% extra passenger traffic to be carried for which an allocation of Rs. 1480 crores would have been necessary against the actual allotment of only Rs. 1125 crores. Shri Chakravarti nevertheless expressed his optimism about the future outlook for the railways. The accent would have to be on further improving efficiency and he had every confidence that with the co-operation of the public, railwaymen throughout the country would ring true to the clarion call to fill this big gap by putting in the extra effort that would be necessary so that the Nation's goods would be delivered.

Electric and Diesel-Electric Motive Power by G.E.C.

IN its works at Witton, Birmingham, and Dudley Port, near Wolverhampton, The General Electric Co. Ltd. of England manufactures traction equipment for all types of electric and diesel-electric railway motive power. Complete locomotives and rolling stock for all electrification systems and voltages and for diesel-electric services are supplied in conjunction with leading British manufacturers of mechanical parts.

The Blue Train of the South African Railways leaving Cape Town Hauled by N. B. L. —G.E.C. 3,000V. D.C. electric locomotive.

Orders in hand and work recently completed are representative of the many different railway operating requirements of which the Company has experience. Following the decision of British Railways to adopt the 50-cycle, single-phase system of a.c. traction, equipments are in production for multiple-unit, suburban trains and for main-line locomotives to operate on a normal line voltage of 25 kV, with automatic changeover for running on a 6.6 kV supply on sections where clearances are restricted. The seventy suburban train a. c. equipments now in course of manufacture for British Railways are for installation in three-coach units each comprising a driving trailer, motor coach, and second driving trailer. The power equipment will be mounted on the motor coach underframe, and the battery, battery charging equipment and compressor, will be carried on the underframe of the second driving trailer.

The motor coach transformer, the switchgear for series or parallel connection of the primary winding to permit operation on 25 or 6.6 kV, and the cam group tap changer in the secondary circuit for control of the traction motor voltage, will form a single assembly, all parts being oil-immersed and cooled by forced oil circulation.

The alternating current will be rectified by a group of single-anode rectifiers with liquid cooling by forced circulation. Smoothing of the d. c. input to the traction motors will be provided by air-cooled chokes.

The four axle-hung, nose-suspended, self-ventilated traction motors will be rated at 200 h.p. (one-hour) and will be designed specially for operation on d. c. with a ripple component. Silicone insulation (Class H) will be used for the traction motors and smoothing chokes. The motor contactors, weak-field contactors and reverser will be electro-pneumatic. All auxiliary machines will be driven by rectifier-fed d. c. motors supplied from a low-tension tertiary winding on the transformer. Overall protection of the equipment will be given by an air circuit-breaker, which, with pantograph, will be supplied by British Railways.

Acceleration will be automatically controlled and the control scheme will provide a shunting notch followed by three running notches, in the last of which the motors will operate in weak field.

Ten complete main-line locomotives are also being supplied for the British Railways 50-cycle electrification. This design has been developed in close collaboration with the North British Locomotive Co. Ltd., who will build the mechanical parts. Five of the locomotives will be geared for a top speed of 100 m. p. h. and five for 80 m. p. h., but both versions will be mixed traffic units in the fullest sense for those with the 100 m. p. h. gear ratio will be able to haul mineral trains of up to 950 tons at 55 m. p. h. The loco-

motives geared for 80 m. p. h. maximum will be capable of hauling a 1,250-ton freight train between Manchester and Willesden (London) at an average speed of 42 m. p. h., including four one-minute stops and observance of all speed restrictions, with a top speed of 55 m. p. h.

The locomotive body will be of special light-weight construction using light steel sections, the underframe, sides and ends forming an integral load-bearing structure. It will be carried on two two-axle bogies, in which the traction motors will be fully-springborne and will be geared to the axles through spring drives. There will be a driving cab at each end of the body. Weight in working order will be 80 tons and the continuous rating 3,300 h. p. The tractive effort at starting is a maximum of 60,000 lb.

Control of the locomotive will be effected on the high-tension side of the transformer. For 25 kV operation the regulating transformer will act as an auto-transformer, the voltage across the tapped portion of the winding being 6.6 kV. When running on 6.6 kV the tapped portion only will be in circuit, the necessary switching for either line voltage being effected automatically. By means of the tappings a variable voltage will be supplied to the primary of the main step-down transformer feeding the traction circuits, the maximum on either contact line voltage being 6.6 kV.

The main and regulating transformers, high-tension tap-changer and the selective switchgear for alternative line voltages will form a single assembly, all parts being oil-immersed and cooled by forced oil circulation. An air-blast circuit-breaker will protect the electrical equipment.

The alternating current from the main transformer secondary will be rectified by a group of single-anode rectifiers, the d. c. output from which will be smoothed by air-cooled chokes and fed to the forced-ventilated traction motors.

Principal auxiliaries will be powered by d. c. motors fed from a mercury-arc rectifier or from d. c. generators. A special winding on the transformer will provide a supply for electric heating in rolling stock.

A 625 h. p. diesel-electric locomotive for the Ceylon Government Railway built by the North British Locomotive Co., Ltd., with G. E. C. power equipment.

The rectifiers to be used in the foregoing 50-cycle, single-phase equipments have a particularly favourable power/weight ratio and are of small dimensions, the design having been developed specially to meet the requirements of installation in locomotives and motor coaches.

DIRECT CURRENT TRACTION

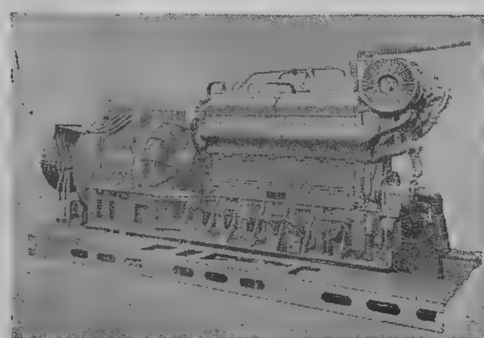
Last year the semi-express type rolling stock, for limited-stop services on the 1500V d.c. electrification between London (Liverpool Street) and Southend-on-Sea—a popular resort and large residential area at the mouth of the River Thames—was introduced. The equipments supplied by the G. E. C. for the 32 four-coach multiple-unit trains built by British Railways for these services are representative of the Company's latest practice for the 1,500V system. Each motor coach is powered by four axle-hung, nose-suspended motors, the two motors in each bogie being permanently in series and controlled by series or parallel connection of the two pairs. Ratings of a four-coach unit are as follows :

	Full-field	Weak-field
1-hr.	800 h. p.	880 h. p.
Continuous	632 h. p.	696 h. p.

Two rates of automatic acceleration, selected by alternative "forward" positions of the reverser handle, are available. The normal rate is 1.1 m. p. h. p.s., while the lower rate, intended for use in greasy rail conditions, is 0.85 m. p. h. p. s. The electro-pneumatic contactor control equipment, with the relays, reverser and motor cut-out switch is accommodated in three cases mounted in the motor coach underframe, and is operated from master controllers in the driving trailers at each end of a unit, the motor coach being the second vehicle from one end. In the main contactors the butt contact interlocks, protected by "Perspex" covers, and the electro-pneumatic valves are mounted at the front so that both are accessible when the front covers of the equipment cases are removed.

In this stock as in other recent G. E. C. equipments the tripping of an overload relay is arranged to illuminate an indicator lamp in the unit affected through a contactor which latches in. Consequently the lamp remains alight after the driver has reset the overload relay from his cab pushbutton, and as long as the control key is in position, identifies the motor coach in which the overload has occurred. The indicator lamp contactor is reset by the maintenance staff at the depot when investigating the cause of the overload or its effects.

In supplying equipment for electric rolling stock the G. E. C. provides from within its own organisation the electrical services which contribute to the comfort and convenience of railway travel. Typical of the facilities available is the toilet water heating installation in the Southend stock. The $1\frac{1}{2}$ kW, 1-gal. water heaters in each toilet compartment are thermostatically controlled via contactors in underframe equipment cases. A special locking device is incorporated to secure the thermostat at any of three temperature settings so that it is unaffected by vibration, and the complete heater is thoroughly shock-tested.



Engine-generator set supplied by the G. E. C. for Ceylon Government Railways 625 h. p. diesel-electric locomotives. The engine is a Davey, Paxman 12 RPHXL 12-cylinder vee type.

Four-coach multiple-unit set with G.E.C. electrical equipment for the Liverpool Street—Southend Service, British Railways, Eastern Region.

The Company is also supplying electrical equipments for 57 three-coach multiple-unit sets which are about to go into service on the London suburban routes of the London Midland Region, British Railways, from the Euston and Broad Street termini. These trains operate on a 630V d.c. third—and fourth-rail supply and incorporate an improved design of shoegear in which rubber is used as a noise-damping and springing medium. The power busline connections between coaches, through which the various sets of shoegear in a train are interconnected, are provided by jumpers and receptacles of a new design in which line contact with the plugs is obtained by the use of spring-loaded fingers. Air-operated cam groups are employed for reversing and field-weakening. In addition to two rates of automatic acceleration selected from the reverser handle, an emergency setting of the accelerating relay can be obtained by operating a normally-sealed push-button if it is necessary to start against a severe gradient with one pair of motors of the four-motor equipment cut out of circuit.

Ratings of a unit of these London Midland Region trains are as follows :—

	Full-field	Weak-field
1-hour	680 h. p.	740 h. p.
Continuous	540 h. p.	600 h. p.

The two motors in each bogie are permanently in parallel and are controlled by series or parallel connection of the two pairs.

Other low-voltage d. c. equipment supplied by the G.E.C. includes large numbers of motors for the underground and tube lines of the London Transport Executive, the latest design being an 80 h. p. (continuous rating) machine for new prototype tube trains in which one axle of every bogie will be motored. An air-operated camshaft controller for tube rolling stock has been developed, and two experimental regenerative equipments are being supplied for the Executive's trials with regenerative braking in tube stock.

D. C. ELECTRIC LOCOMOTIVES

The efficiency of the modern d. c. electric locomotive as an operating unit is based both on the wide range of duties a single design can undertake and on high availability resulting from minimum maintenance requirements. Several years' service of the 3,000V, 3,030 h. p. Class "4E" locomotives on the South African Railways have demonstrated their merits in both respects. The locomotives were built by the North British Locomotive Co. Ltd. and equipped by the G. E. C. for service on the Cape Town-Touws River section of the main line to Johannesburg. Heavy gradients in the Hex River Valley imposed special requirements, such as the ability to start a 1,070-ton goods train on a 1 in 66 grade, or a 610-ton passenger train on a 1 in 50 grade. Regenerative braking alone was required to hold trains of these two types at speeds of 25 to 40 m. p. h. and 40 to 55 m. p. h. respectively down a gradient of 1 in 66. To meet these braking demands the locomotives are equipped for regeneration in all three groupings of the six traction motors, while flexibility of control when motoring is obtained by the provision of three weak-

field notches in each grouping. Two of the locomotives can be operated in multiple when required.

In these locomotives the lateral forces imposed on the track have been considerably reduced by allowing the motors a limited amount of transverse movement relative to the axle under the control of rubber springs, between the motors and the bogie frame.

BATTERY LOCOMOTIVES

On electrified systems provision must be made for hauling trains for permanent way and other maintenance duties when power is off. Numbers of equipments for work of this type have been supplied by the G. E. C. to the London Transport Executive for installation in battery locomotives. In this particular instance provision is made for taking a supply from the third rail when power is available. The control system is designed to permit very fine control at crawling speeds when cable-laying as well as for running at speeds which do not interfere with normal traffic. These service conditions have resulted in the development of equipment able to meet economically any requirements likely to be put forward for battery locomotives or passenger vehicles.

DIESEL-ELECTRIC TRACTION

At the present time the G. E. C. has orders in hand for the diesel-electric traction equipment of high-speed Pullman trains, main-line locomotives and shunting locomotives. The five high-speed trains, which are being built by the Metropolitan-Cammell Carriage and Wagon Co. Ltd., Saltley, Birmingham, will operate on British Railways between London and Bristol, London and Manchester, and London, Birmingham and Wolverhampton. There will be two power cars in a train, each with a machinery compartment containing a N. B. L./M. A. N. 1,000 h. p. pressure-charged vee 12-cylinder engine direct-coupled to a G. E. C. single-bearing main generator with belt-driven auxiliary generator. Eight self-ventilated traction motors will be distributed through the train. The motors will be fully-springborne in the bogies and will be geared to the axles through Brown-Boveri spring drives. Cooling air will be supplied to the motors through ducting from protected intakes.

The control system will comprise a combination of main generator field control and engine speed variation, with automatic torque control through an oil servo-regulator. A range of several engine speeds will be provided by means of three air-operated pistons acting on the engine governor through a system of interconnected levers.

Equipments are being supplied for 20 Bo-Bo locomotives being built by the North British Locomotive Co. Ltd. for British Railways in connection with the British Transport Commission's modernisation programme. One of these is a 1,000 h. p. design powered by a 12-cylinder N. B. L.—M. A. N. engine and the other a 800 h. p. locomotive with a 16-cylinder Paxman YHXL engine. In each case the diesel engine will be direct-coupled to a G. E. C. main generator with overhung auxiliary generator, and the four axle-hung, forced-ventilated traction motors will drive the axles through Wiseman resilient gearwheels. When running on any power notch, transitions between full-field and weak-field in the traction motors, both forward and backward, will be made automatically, thus ensuring maximum utilisation of engine power over a very wide speed range.

In G. E. C. diesel-electric equipments for horsepower ratings of the above order, the control system operates by a combination of main generator field control and variation of engine speed. An automatic load control system, acting on the main generator field, is available on all controller notches, and although it does not normally come into action on the lower engine speeds

Motor bogie of N.B.L.—G.E.C. 3,030 h.p., 3,000V d.c. locomotive for the South African Railways.

it acts immediately to relieve over-loading should the engine power output fall for any reason while running on any notch. Otherwise, the system acts to match the generator output to the power demand over the widest possible range of locomotive speed, ensuring that the output is fully utilised and protection is given against overloading the diesel engine.

The oil servo regulator in the automatic load control system provides very finely-graded adjustment of the field circuit resistance in a compact form by means of numerous tappings connected to the segments of a fixed commutator, around which brushes are moved by the servo mechanism. The vane type servo motor ensures precise adjustment to varying conditions with negligible hunting.

Many of the British Railways 350 h. p. standard 0—6—0 diesel-electric shunting locomotives are now being powered by the G. E. C. The equipment supplied for duties of this type comprises a Lister-Blackstone 6-cylinder vertical 4-stroke engine with a flange-mounted main generator, on top of which are mounted an auxiliary generator and a traction motor blower, both belt-driven. The generators and blower from a combined unit with the engine, thereby dispensing with the need for a separate bedplate, but they can be detached from the engine as a single combined assembly.

With the diesel engine running at idling speed, ten steps of generator field control provide control of the locomotive speed, after which the engine speed can be adjusted continuously between idling and maximum r. p. m. to provide a stepless control which is of particular value on shunting duties. Series or parallel connection of the two traction motors is selected by means of an off-load switch. When running in parallel with the controller moved to its furthest extent, generator excitation is increased automatically subject to the overriding control of a voltage relay which restricts working in these conditions to the upper part of the speed range. The controller and reverser handles are duplicated at each end of the desk to permit driving from either side of the cab.

In these shunting locomotive equipments the drive is through double-reduction gearing. The whole gear train is located on the same side of the traction motor, which facilitates demeshing when a locomotive has to be towed. The hollow intermediate shaft and its roller bearings are mounted in eccentric housings which are joined by a spindle passing through the hollow shaft. A square end on this spindle projects beyond the inner bearing cap so that it can be turned by a spanner. Two bolts lock the bearing housings in the meshed or demeshed positions, and after they have been removed, rotation of the spindle by the spanner moves the gears into or out of mesh as required. The operation can be carried out quickly and easily by one man.

GENERAL DEVELOPMENT

Means of increasing the output from G. E. C. traction machines are being studied continuously and improvements have been effected in the transfer of heat from windings to the cooling air, giving higher output for a given temperature rise. Practical experience has also been gained in the use of Class H insulation, which permits higher operating temperatures. Investigations of bogie construction, and of adhesion with various methods of motor combination and control, have contributed to understanding of the fundamental problems common to all types of locomotives and rolling stock powered by electric motors.

The G. E. C. organisation as a whole enables the Company and its associates to supply complete equipment for railway electrification from its own resources, including substation plant, distribution cables and overhead line equipment, remote supervisory control systems, signalling installations, and all electrical services for rolling stock.

JAPAN PLANS TO SELL STEEL CHEAPER

Japanese steel mills are planning drastic cuts in export prices in view of intensified competition in world markets. The Fuji Iron and Steel Company said Japanese steel exporters had been beaten in recent weeks by European exporters who offered semi-finished steel billets at 88 dollars and round steel bars at 98 dollars, both per ton f.o.b. The low priced semi-finished steel was offered by Swedish exporters at an international tender held in Argentina. To compete with such a price, Japanese semi-finished steel must be exported at about 83 dollars per ton, f.o.b., because of larger freight costs from Japan to Argentina.

A Century of Rollingstock Production in Sweden

By An Engineering Correspondent

MORE than a century has elapsed since 1847 when the present firm was founded under the name of Trollhatte Mekaniska Verkstad (The Trollhattan Engineering works). In 1850 the name was altered to Nydqvist & Holm, and in 1916 the firm was converted into a limited company under the name of NYDQVIST & HOLM AKTIEBOLAG. (NOHAB).

To start with the range of manufacture comprised water turbines, steam engines, and various machine parts. After a few years the manufacture of locomobiles was taken up, and the step was then not for to locomotives, which, as a matter of fact, from the very beginning had been contemplated as a future speciality. The first order for locomotives was from one of the private railways in Sweden and the delivery began in 1865. One of these locomotives is now in the Railway Museum, Stockholm and another of them was in service for 70 years before being sent to scrap yard. Many locomotives of NOHAB's make are after more than seventy years still in daily service. The first three locomotives built for the Swedish State Railways were delivered in 1868.

The Directors of the company have always been anxious to make use of all improvements in the locomotive sphere and in this connexion it may be mentioned that compound gears and superheaters were applied at a comparatively early stage, and further, amongst the first 3-cylinder locomotives in Europe were those supplied by this firm in 1913. In 1925 the firm commenced to build steam turbine locomotives under licence from Aktiebolaget Ljungstroms Angturbin, Stockholm, and amongst engines of this type may be mentioned the non-condensing turbine locomotives for iron ore transport, supplied by Nohab to the Trafikaktiebolaget Grangesberg-Oxelosunds Jarnvagar (The Grangesberg-Oxelosund Traffic Co.'s Railway).

Sweden's richness in water power soon led to the electrification of the Swedish State Railways. Electric locomotives had been built by Nohab before 1900, but it was first in connection with electrification of the State railways that the manufacture of such locomotives became of real significance. The first of these locomotives was of the type 1-C-1, a coupling rod type of locomotive, of which Nohab have since delivered a great number. During recent years several private railways have been electrified and locomotives of various types for these railways have been built by us.

Completion from omnibuses and lorries has, in instances where electrification has not been considered suitable, compelled the railways to motorise the service, and this induced Nohab to take up the manufacture of motor driven locomotives and rail cars. The first rail car built was of the 4-wheel type but nowadays Nohab rail cars are normally of the 8-wheel type with two bogies.

Nohab's manufacturing programme comprises not only locomotives and rail cars but also other kinds of rolling stock, such as special wagons of various types, rotary snow ploughs and impregnating plants.

To meet the ever increasing demands considerable extentions of workshops have been carried out time and again. The works originally covered an area of 8,300 square metres, and now extend over more than 205,000 square metres. The shops with a floorspace of 59,000 square metres are full equipped and up-to-date in every respect.

Location of the works at Trollhattan was to a large extent dependent on access to water power and to a waterway to Gothenburg, Sweden's largest port. In 1922 a special quay was built and equipped with a crane allowing assembled locomotives to be lifted on board ships, specially built for the transport of locomotives. Messrs. Nohab has their own railway, with a length of 3 kilometers, connected to the Swedish State Railways and thereby also to the Continent. Trial runs of locomotives are made on their railway. There is also a

One of the NOHAB–GM locomotives delivered to the Danish State Railways

connection to the narrow gauge railway system of Western Sweden.

Prompt deliveries of locomotives have made the firm known far beyond the borders of Sweden. Scandinavia and Finland have early been their customers. Amongst other countries, to which Nohab has supplied rolling stock of various kinds, may be mentioned, the Argentine, Brazil, Iran, Netherlands, Poland, Portugal, Rumania, Turkey, U.S.S.R., and the Union of South Africa. Firm's deliveries have been large, especially to Iran, Turkey and U. S. S. R. In 1920, the Soviet Government ordered 1,000 heavy goods locomotives, one of the largest contracts in the history of the locomotive industry, as a result the firm had to make large extensions of their works, In order to utilise the increased capacity of the works it was necessary to look for new markets.

Early in 1927 the Turkish Government favoured the firm with a rather unique and complicated commission. The contract entered into comprised the building of railways with a total length of 900 kilometers, and the delivery of 100 locomotives and 1,500 coaches and wagons of different types. The railways were built in collaboration with the Danish firms Kampmann, Kierulff & Saxild A/S and J. Saabye & O. Lerche. The rolling stock was supplied by Nohab. The whole contract was completed in nine years. The enterprise was followed by a similar commission given by the Iranian Government to the three collaborating firms, who under the name of "Consortium Kampsax" undertook the building of the Transiranian Railway. Nohab supplied the rolling stock, consisting of locomotives, goods wagons, coaches, diesel-electric rail cars, some special wagons and a saloon-car for H.I.M. the Shah.

Since April 1950 there exists an agreement between Nohab and the General Motors Corporation, Electro Motive Division, La Grange, with a view to build and market diesel-electric locomotives utilising General Motors Corporation's constructions and equipment sets consisting of diesel engine, main generator and other supplementary equipment.

The Swedish locomotive builders formed in 1945, a sales company, Swedish Locomotive Works Association Aktiebolag for the export of steam locomotives. Nydqvist & Holm Aktiebolag is a member of that Association.

NEW TYPE OF CRANE FOR DURGAPUR

Demonstrations illustrating many advances in design have been given at the works of a British engineering company which has recently completed orders for self-propelled and rail-mounted cranes for the new Indian steel works at Durgapur and other Indian iron and steel plants.

A four-minute operation by one crane involved the hoisting of an overhead travelling crane weighing 10 tons to a height of 35 ft. and then, with great precision, placing it delicately upon the tracks. The crane was a 25-ton capacity, self-propelled type fitted with a 60 ft. strut jib.

On all the cranes used in the demonstration, the Diesel-electric transmission system was featured. This consists of a Diesel prime mover driving a shunt-wound generator which, in turn, supplies current to separate motors for each of the crane motions. It is stated that one great advantage of this system is the resulting reduction in fuel consumption, since the engine is not kept running at high speeds, power being developed according to needs.

This variable-voltage system provides an infinite variation of speeds, smooth acceleration, controlled lowering under power, and a high degree of accuracy. As an indication of the degree of precision, a five-ton-capacity crane lifted a steel tube and lowered it into another with such fineness of control that it did not unbalance or move in any way. There was only one-eighth of an inch clearance between the two tubes.

The British company concerned (Steels Engineering Products Ltd., of Sunderland), besides the seven cranes supplied for Durgapur, has delivered one self-propelled crane for the Indian Iron & Steel Co. of Burnpur, two rail cranes for the Tata Iron & Steel Co. of Jamshedpur, and several others for constructional companies carrying out work at Indian iron & steel plants.

SEA TRANSPORT SECTION

The Great Eastern Shipping Co. Ltd. — Spectacular Record of Progress and Expansion

IN less than ten years the Great Eastern Shipping Company has set up a new record in the expansion of Indian Shipping under Indian management. It has shown how, given a combination of business enterprise with judicious State encouragement, the progress that would otherwise take many years, can be compressed within a few.

The Company was established in August, 1948. It commenced its business with one ship s. s. "Jag Vijay", which had been purchased from the United States Maritime Commission. In 1950 orders were placed for the building of two ships with a Japanese Shipyard. These two ships were named as "Jag Ganga" and "Jag Jamna". The Great Eastern was the first Indian Company to build ships to order in Japan.

The Coastal reservation for Indian ships and the encouragement given by the Government in the shape of loans to Indian Shipowners for the purchase of vessels gave a stimulus to further expansion of the Great Eastern. In 1952 s. s. "Jag Rani" built at the Visakhapatnam Shipyard was purchased by the Company. By the end of the First Five Year Plan period, three ships were added to the Company's fleet. This included s. s. "Jag Tara" built at a Norwegian Shipyard.

The Company has also pioneered in the tanker line in India with the purchase of the tanker "Jag Jyoti" in April 1956 at a cost of about Rs. 90,00,000/-. The motor ship "Jag Laxmi" built by a Japanese Shipyard and delivered in February, 1957 is the largest ship on the Indian Registry with a deadweight tonnage of 12,970. In June 1957 s. s. "Chepman" which has been renamed "Jag Janani" was added to the fleet. Two ships of 14,200 deadweight and 6,000 deadweight are being constructed on account of the Company at a West German Shipyard and the Visakhapatnam Shipyard respectively.

The Company has also purchased recently s. s. "Durham Trader" under the "Pay while you earn" scheme initiated by the Government.

The Company maintains regular cargo service on the coast of our vast Peninsula. The Great Eastern is the only shipping company engaged in the international tramp shipping.

The Managing Agents, Messrs. A. H. Bhiwandiwalla & Co. (Bombay) Private Ltd., have far-flung business interests in the country. Mr. Vasant J. Sheth, who as a Director-in-charge manages the affairs of the Company has been associated with the Company since its inception. The Managing Agents realise that the prosperity of the Company can be built up only on the foundation of a highly efficient service to others, on the prosperity and goodwill of both shippers and consignees, and on no other. In short, their guiding motto has been — PROSPER THROUGH BETTER SERVICE.

BRITISH STEEL FOR INDIAN RAILWAYS

Large quantities of steel will be supplied by British Steel Makers to the Indian Railways during 1958. Contracts placed include 30,000 tons of Rails, 15,000 tons of Steel Sleepers and over 10,000 tons of Fishplates, costing some £ 2¼ million. Shipments are expected to start early in the New Year.

OVERSEAS SHIPPING TARGET FOR INDIA

how to achieve it

By C. H. Bhabha

WITH all our grandiose schemes and projects for economic planning and development, since the attainment of our Independence, ten years ago, the slow pace at which Indian shipping has moved forward, is a matter of deep regret and a great blow to our national hopes and aspirations. This vital limb of our economy, which everyone welcomes and wants to acquire unexceptional vigour and rapid expansion, remains unfortunately even today in a state of comparative inertia and undeserved neglect. One feels a sense of frustration and despondency when one examines dispassionately and objectively the achievements of a decade of this important facet of our national growth. Since the dawn of Independence, "brave in words but timid in deeds", seems to be the key-note of our shipping policy. Performances are in conflict with promises. Assurances keep miles away from actions. The early enthusiasm and drive which produced some remarkable results soon after freedom in carrying the Indian Flag forward have given place to inexplicable indifference and unpardonable lethargy.

The old spirit of diffidence, the continuous inertia resulting from red-tapism and the woeful lack of courage and foresight to take timely decisions and vigorous action are mainly responsible for the comparatively minor place and low priority which our benign rulers have assigned to our shipping without which we cannot promote our economy, preserve our security, maintain our strategy and discharge our international obligations. Barring some forms of cheap loans accompanied by rigours of regulations and controls and the slowly hastening patronage of Government cargoes to be carried often at concessional and unprofitable rates, no other measure of actual help and encouragement has so far been taken by our national Government to fulfil the urgent needs of the country for building up a crucial and vital industry like shipping.

COASTAL RESERVATION NEGLECTED

Undoubtedly, as a result of India's destinies shaped by her own countrymen, the coastal trade was reserved for the ships flying the Indian Flag. This long overdue measure created a healthy atmosphere and a buoyant spirit in the Indian shipping world. This, however, did not last long. Our new hopes were soon blasted. Over four million tons of crude oil imported and nearly two million tons of petroleum products carried round the coast by the three Indian Oil Refineries were allowed to be moved by foreign tankers. The opportunity of building up a tanker fleet for the import of four million tons of oil was not utilised. Although the three refineries were Indian companies and although several concessions were given to those refineries, no step was taken for arriving at an arrangement for importing crude oil by Indian tankers. As if this was not enough, even the refined petroleum products were also allowed to be carried in foreign tankers round the coast of this sub-continent, although the coastal-trade was reserved for national ships. This gave a deadly blow to India's national honour and pride. It is, however, some solace that after considerable pressure, one tanker in the private sector has been allowed to move the refined products round the coast and it is hoped that a second tanker in the public sector will be allowed to do so from March 1958. It is, however, a pity that while foreigners are accorded the same treatment as given to Indians, when they start companies in India with Rupee Capital, Government miserably failed to enforce on them the just obligation of giving the first preference to the national ships of the country in bringing the raw materials they need or the finished products which they want to carry.

FACTORS THWARTING PROGRESS

The Planning Commission has estimated that the coastal tonnage will reach the figure of 317,202 G.R.T. at the end of the First Plan. The actual tonnage, however, will only be 264,360 G.R.T. There will thus be a short-fall of over 52,000 tons. It is remarkable that this short-fall has not been made good, although more than twenty months have passed since the First Plan came to an end, and despite the appeal made by the Transport Minister in 1955, that Indian shipowners should acquire immediately twenty-five to thirty additional coastal ships. We are constrained to remark that the Government themselves are responsible for this gap remaining unfilled. Rates of freight on the coast are controlled by the Central Government. While the rates of freight and fares are allowed to be increased by the Railways, not only for economic working, but

also for securing additional finance for capital expenditure, and while increases in the fares have been allowed to Air Transport Companies, the same freedom is not given to the shipping companies even to earn a reasonable return on the capital employed by them in their business. The recent acceptance of the recommendations of the Rail-Sea Coordination Committee, to allow the coastal ships to raise their rates of freight by 15%, inclusive of the two previous increases, under a new hush hush policy of the so-called previous consultations with the shipowners, ignores the stern realities of the rise in the cost of tonnage, the growing cost of operations and the increasing needs of funds for building up substantial rehabilitation reserves. It is common knowledge that the figures given in the Report of the Rail-Sea Coordination Committee are highly misleading. The surplus of Rs. 37 lakhs, which they have shown, will turn, if proper calculations are made, into a substantial deficit. We need not examine here the logic and the arithmetic of the Rail-Sea Coordination Committee. Suffice it to say that with the Government not allowing the rise in the rates of Salt recommended by the Committee, and the Committee not providing for the proper amounts of Income and Corporation Taxes, as a result of the new Taxation Policy, etc., all these reserves will vanish into the thin air. Had the Government not ignored their responsibility of appointing a representative of the shipping interests on this important Committee, the recommendations for enabling Indian shipping to work on an economic basis would have been quite different. The Rail-Sea Coordination Committee have urged that the coastal tonnage must reach 4.12 lakhs of tons by 1959 and have held out the threat that if the shipping companies do not do so, the balance of the tonnage should be acquired by the Government themselves. The Government contend that they wish to build up Indian economy under democratic methods. Free Enterprise cannot invest, however, crores and crores of rupees in a hazardous industry like shipping, with the prospects of incurring heavy losses. It is, however, no wonder that Indian shipping should not expect any better treatment from the Free and Independent Government of India, when shipping continues to be treated as the Cindrella of the Industrial World.

INACTION—A GRAVE CRIME

The main problem of Indian shipping, which has been causing serious concern to every patriotic Indian today is the very poor progress which Indian shipping has made in the carriage of India's overseas trades. It is well-known that the national prosperity of many important and progressive countries of the World is largely due to the development of shipping services for the substantial carriage of overseas and cross trades. It is ostrich like for our authorities to bury so prominently seen in the historical firmament of war-shattered economies, like those of West Germany, Japan and Italy. Attempts are unfortunately made in the highest quarters to justify the inaction of the Government on the ground "that it would be unrealistic to expect the pace of development and achievement in India to bear any comparison whatever, with that in the countries of the West who have had a long start and who have taken quite a long time to reach the stage where they are". This lack of faith and determination does not overpower the Government, when they have to make rapid progress for building up the Steel Industry, but it unfortunately makes them faint hearted when the building up of shipping services, vital for defence and a great earner of foreign-exchange, is concerned. Failure to take cognizance of the valuable lessons which war-shattered countries teach us and to adopt energetic measures for expanding the shipping tonnage for carrying our overseas cargoes will not only be a serious blow to our national interests, but it will also be a grave crime against the democratic form of Government, which we are taught to cherish as our greatest treasure in life. Let the Government remember that the posterity will judge them not by their words but by their deeds.

"SMALL OVERSEAS TONNAGE"

Shipping is an international business needing all possible facilities and assistance to establish itself firmly, particularly under difficult competitive conditions in overseas waters. When all the seventeen ships, which were under construction at the end of the First Plan, would be delivered by the middle of 1958, 86 ships of about 264,000 tons will be employed on the coast and 51 ships of about 347,000 tons will be employed in the overseas trades of India. It is true that further commitments have been made for the construction and/or acquisition of overseas tonnage to the extent of about 142,000 G. R. T., but the ships representing this tonnage are not likely to be delivered before the end of the Second Plan. It will be impossible for the Indian ships to carry even 15% of India's overseas trades, as visualised by the Planning Commission and the Transport Ministry, with such small overseas tonnage.

India ranks seventh in the world in the matter of international trades. According to the recent Report of the Export Promotion Committee, India's foreign trades represented 3.56% of the total world trades in 1956. Both the volume and the value of our foreign trades have increased during the last quinquennium—thanks to the energetic revitalisation of India's economy. The following figures (according to the Report of the Reserve Bank on CURRENCY AND FINANCE 1956-57) will give an indication of the extent to which the values of our overseas trades have gone up :—

Year	*Total value of imports and exports*
1952—53	Rs. 1,234.9 crores
1953—54	Rs. 1,131.5 „
1954—55	Rs. 1,280.4 „
1955—56	Rs. 1,391.7 „
1956—57	Rs. 1,713.5 „

RAPID RISE IN TRADE

As regards the volume of our international trades, no accurate statistics are unfortunately available. From the reports, however, of the working of the five of our major ports, viz., Calcutta, Vizagapatam, Madras, Cochin and Bombay, we note that the tonnage handled at these ports has gone up from 18.5 million tons in 1948-49 to 23.6 million tons in 1955-56. It is also observed that the total tonnage handled at all the ports in India in 1955-56 exceeded 30 million tons. While separate figures for the movement of cargoes in the coastal and in the overseas trades are not available in each case, from such figures of the tonnage moved in the coastal trade as are given in the Lok Sabha and from other reliable sources, it is estimated that about 18 million tons of cargoes were carried in the international trades of India in 1955-56.

As regards the tonnage, India had the following tonnage at the beginning and at the end of the First Plan.

	Coastal ships		*Overseas vessels*		*Total*	
	No.	*G.R.T.*	*No.*	*G.R.T.*	*No.*	*G.R.T.*
On the 1st April 1951.	73	217,202	24	173,505	97	390,707
31st March, 1956.	81	241,896	39	261,007	120	502,903

The above figures tally more or less with the figures given by the Rail-Sea Coordination Committee of 494,242 G. R. T. in their latest Report.

PLAN TARGET & OVERSEAS TRADE

Let us now examine the tonnage that is likely to be added to the above figures in the international trades of India during the Second Plan period and the extent to which the volume of the cargo to be carried in the international waters is likely to go up during the same time.

There were 12 overseas ships of 86,725 G. R. T. under construction on the 31st March, 1956. Orders have been placed for the purchase or construction of 20 additional ships of 142,100 G. R. T. during the first year of the Second Plan. All the 12 ships under construction on the 31st March, 1956, are likely to be delivered by the middle of 1958. Ships which have been ordered during the Second Plan period will be delivered during the last year of the Second Plan, or the beginning of the Third Plan. Even when all these ships are delivered, India's overseas tonnage will only be 71 vessels of 489,832 G. R. T. It is, therefore, obvious that India cannot carry 15% of her growing overseas trades even with that tonnage.

As stated above, the volume of India's overseas trades was about 18 million tons in 1955-56. According to the Report of the Estimates Committee on Shipping, 11.95 lakhs of tons dead-weight cargoes were carried by Indian ships in the overseas trades in the calendar year 1955. This represents a little over 6% of the total trades. The Estimates Committee, in their Report on Major Ports, have, however, pointed out that according to the information given by the Ministry of Commerce and Industry to the Ministry of Transport, additional six million tons of imports and exports would be brought or carried from India by the end of the year 1958. This would mean that the total of the overseas trades would go upto 24 million tons before the end of the Second Plan. If, in addition to this, the negotiations for the export of Manganese and Iron Ores to Japan materialise, the

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volume of overseas trade will go up by another six million tons per year and reach the figure of million tons by March 1961. Both the Planning Commission, as well as the Transport Ministry are anxious that Indian shipping should carry at least 15% of India's overseas trades. The minimum tonnage which Indian ships will have thus to carry in international waters would be 36 lakhs of dead-weight tons and if the negotiations for the sale and carriage of Ores materialise, Indian ships will have to handle 45 lakhs of tons of dead-weight cargoes in India's overseas trades. As stated above, when all the tonnage will be delivered, Indian shipping will reach the figure only of 489,832 G. R. T. The maximum which Indian tonnage would then be able to carry would be about 18 lakhs of deadweight tons. This would be only 6% of the total cargoes of 30 million tons. In other words, not only will Indian shipping make no progress in the carriage of overseas trades by the end of the Second Plan, but it may also be possible that Indian shipping may receive a little set back in the percentage of the total volume of cargoes which it may handle by 1961.

NO PROGRESS IN INTERNATIONAL WATERS

Let us not, therefore, continue any longer merely toying with our plans and programmes for the development of Indian Merchant Navy. Let us not forget that soon after we attained Independence, the Expert Shipping Policy Committee, appointed during the British regime, submitted its report, which was accepted by our new national Indian Government as its Bible for the future policy in respect of India's Mercantile Marine. Thus, even as far back as 1947, the Government of Independent India, announced that India should possess a merchant fleet of at least two million tons within a period of five to seven years, that is at the latest by 1954. This target of two million tons was expected to cater for the carriage of the entire coastal trade, 75% of India's adjacent trades and at least 50% of her overseas trades. It is really unfortunate that while we have not reached even 30% of the target in 1957, which we were expected to reach in 1954, India has made no headway in the carriage of her trades in international water and her tonnage today is even less than ½% of the tonnage of the world, while her international trade is, as stated above, 3.56% of the world trade.

SERIOUS DRAIN ON FOREIGN CURRENCY

The implications of this unfortunate situation on our economic growth are bound to be more serious than they are generally understood in the country. In the first place, with the increase in our foreign trades, a larger freight bill will have to be paid to the foreign flags out of our meagre foreign-exchange resources. It is estimated that our annual freight bill runs today round about Rs. 140 to Rs. 150 crores. With the rise in our foreign trades of a further six million tons per year, the freight bill is bound to go up by about Rs. 60 crores. It is significant to note that while India imported about 24 lakhs of tons of foodgrains during the first ten months of 1957, she had to pay a little over Rs. 31 crores to the foreign flags for bringing the imports of these commodities as against the sum of Rs. 25 lakhs paid to Indian ships. The average freight works out at Rs. 127/- per ton. No one can think with equanimity of the serious consequences of this drastic drain on our poor finance exchange resources, which we are called upon from day to day that we should do everything possible to conserve and augment. In the second place, through inadequate increase of Indian tonnage for our overseas trades, the contribution of Indian shipping to the foreign exchange pool of the country will not be commensurate with the rising tempo of economic activities in the land. If we were to carry only 15% of our total estimated trades of 24 million tons by 1960-61—and not 50% of those trades as announced by the Government in 1947—the contribution of Indian shipping to the foreign exchange pool of the country will go up from the present meagre figure of Rs. 7 to 8 crores to Rs. 25 to 27 crores. No Government can ignore their serious responsibility of augmenting the country's foreign-exchange pool to such a substantial extent by the expansion of its shipping tonnage, particularly when it has been faced with a foreign-exchange crisis of unforgettable dimensions.

URGENT RETHINKING NECESSARY

As regards the long-range policy of carrying 50% of our overseas trades in our own bottoms, it is obvious that we shall have to revive substantially our present target of two million tons. We shall have to fix a new target. A properly phased programme will have to be worked out with a definite "D" Line for the fulfilment of this very vital objective. It is essential that urgent steps should be taken by the Government to entrust this important work of fixing the target and drawing up a suitable programme to non-official experts having knowledge and experience of this vital industry. Any further delay now in this respect, will mean nothing but a severe set back to our economy as a whole and will do immense harm to the

laudable objectives of systematical development of our resources for ensuring a balanced economy in the country and thereby raising the standard of life of our teeming millions.

It saddens our hearts to note that a spirit of unwarranted coldness has come over not only on the Government of the country, but it has also unfortunately affected those who are connected and concerned with the shipping industry and are anxious to expand our tonnage commensurate with the growing needs of our overseas trades. Whatever may be the provocative causes which have led to the growth of this harmful spirit, it is necessary for all well-meaning patriots to think afresh and anew about the highly complicated, but essentially vital industry of the country, affecting both its future economy and its future security. In order to create the necessary climate and for searching for a solution for the achievement of the above mentioned modest objective for our overseas trades, a few random suggestions, it is hoped, will prove useful.

ASSURANCE TO CREATE CONFIDENCE NEEDED

As a condition precedent to any regeneration of enthusiasm for achieving the new target for our overseas trades, a comprehensive examination and a radical revision of the Shipping Policy of the Government is urgently called for. Despite all the professions of having a dynamic policy for Indian shipping, the actual measures or steps taken for translating our hopes into concrete achievements or deeds, have unfortunately been feeble and faint-hearted. It can almost be said, without any injustice to anyone, that our Shipping Policy has been halting, hesitating, half-hearted and even heart-breaking. What is now urgently needed is to lay out immediately a bold Policy of Shipping for a long term and to announce specific assurances and concrete measures for that purpose in advance. With a view to develop the Shipping Industry and particularly that branch of the Industry, which will deal with the foreign trades of the country, it is essential to know well in advance the Policy of the State, which will hold the field for a number of years with certain guaranteeing factors in order to create and sustain confidence and also enable all concerned, to take bold action for the acquisition of additional shipping tonnage.

COMPETITION POSSIBLE ON EVEN TERMS ONLY

In the matter of overseas tonnage, we should never forget that it has to face international competition. That aspect of the shipping industry must deserve its fullest weight in the creating of such climate as would help Indian shipowners to go in for those trades. Recognising these particular features of the overseas trades, it is essential that the Government should undertake certain obligations in order to foster a healthy spirit of competition, as well as to remove any hardships or obstacles that may lie in the path of the development of the shipping industry. Even the advanced maritime countries, like the United Kingdom has given a special Investment Allowance of 40% as compared with the meagre Development Rebate of 25% given in this country. If Indian shipowners are to be encouraged to help in this national effort, the least that should be done by the Government is to create terms and conditions for operations for Indian shipping which should not be dis-similar or less advantageous than those enjoyed by foreign shipowners, particularly those who are competing with Indian ships in India's overseas trades.

There is nothing unusual for a Government to extend the patronage of its cargoes to its own ships for building up the Navy of Supply of its own country. It is a matter of satisfaction that the Transport Minister has given the repeated assurance that Indian shipping will be given the first preference for the carriage of Government cargoes. The real trouble is that there is no policy of coordination in the implementation of this Shipping Policy amongst the different Ministries of the Government. When large volumes of cargoes are to be carried on Government account, attempts are always made to drive Indian shipping to the corner and compel it to compete in the matters of rates in the falling chartering market from any tramp ship. When the chartering market is, however, rising the Government do not give the benefit of such a state of the market by giving the Liner ships a higher rate, but quietly ask them to carry the cargo at the usual rates, which are in many cases, far lower than the rates obtaining in the charter market. Such a state of affairs cannot be tolerated if a healthy, strong and vigorous force of Indian ships is to be built up in the larger interests of India. Government must give a definite assurance that at least a certain proportion of cargoes within the control of the Government, will be placed at the disposal of Indian ships at rates not lower than the average rates

(Continued on page 60)

Role of Arc Welding in Steel Economy Project

By S. V. Nadkarni, M. Sc., A. M. Inst. W. (Lond.)

IT is in the fitness of things that arc welding should be called upon to play a major role in big projects everywhere in India to-day. Arc welding has been recognised all over the world as the most versatile and efficient method of joining metals. The Planning Commission has also been quick to realise the need of popularisation of welding in India, of drastic changes in our design and fabrication methods so that riveting is replaced as far as possible by welding. In fact, the Planning Commission has listed "Popularisation of Welding" as a major step in the successful implementation of the Steel Economy Project which is now being looked after by the Indian Standards Institution.

WHAT IS ARC WELDING

Welding may be defined as a method of joining metals by heating the edges or surfaces to a plastic or molten state and allowing them to solidify together with or without the application of pressure. When, in welding, the edges are allowed to melt before solidifying together without the application of pressure, the process is called fusion welding. Fusion welding can be accomplished in two ways : one, in which the heat necessary is obtained from an oxy-acetylene flame, the process being commonly called gas welding and the other in which the heat is obtained from an electric arc, the process being known as arc welding. Arc welding has proved itself to be the most versatile of the various methods and is the most popular.

In arc welding, the arc is struck between an electrode and the base metal to be welded. (See Fig. 1). The electrode is held in a holder with an insulated grip, and this holder is linked by means of welding cable to

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(Continued from page 59)

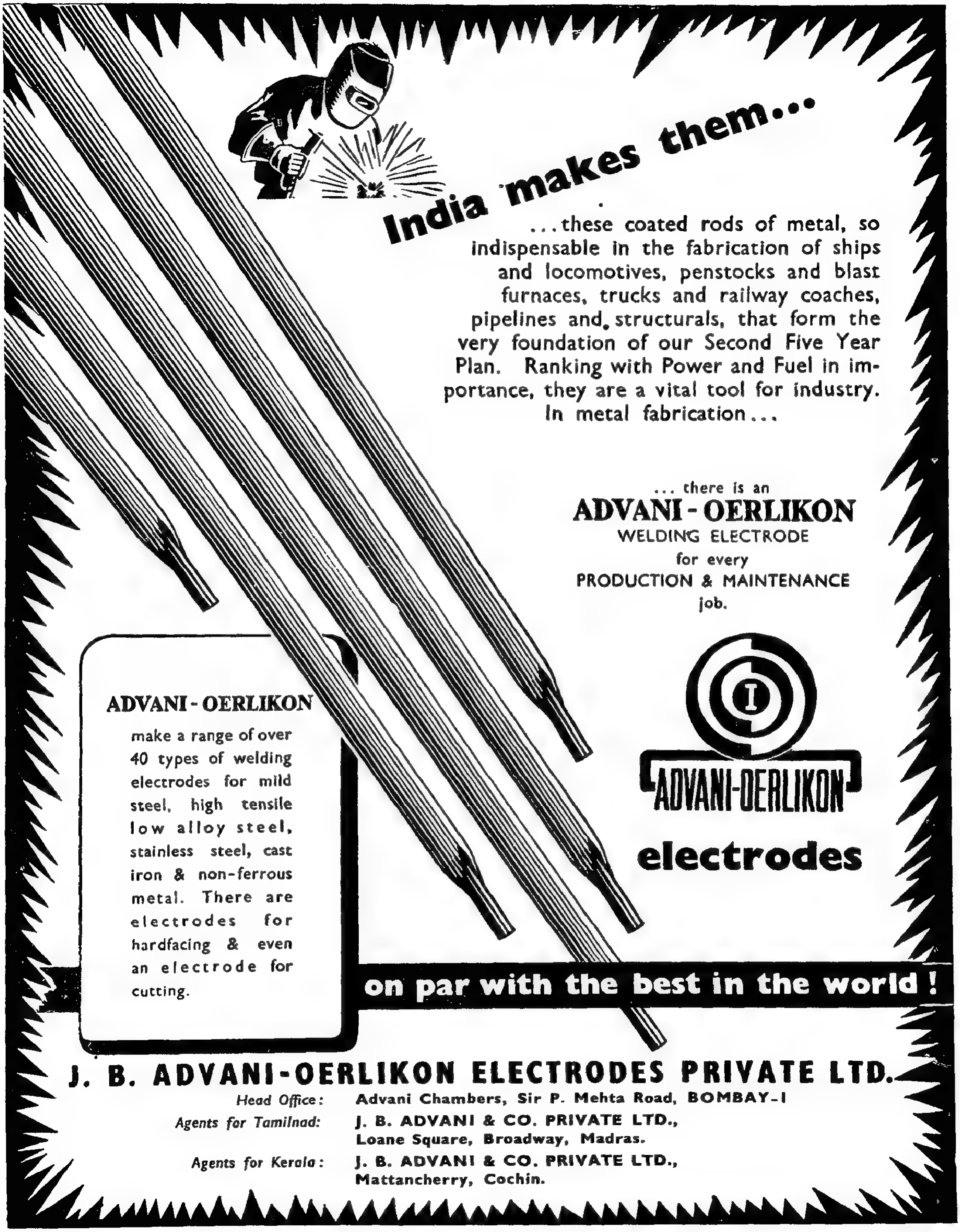
of such cargoes prevailing in that area over the preceding three months or so. With the Government having more and more cargoes within their control, it is essential that some sort of bias and preference is definitely and calculatedly exercised in favour of their carriage by Indian ships. By such action and by such policy, a definite confidence will be created in the hearts of Indian shipowners and will embolden them to acquire larger tonnage for servicing at least the reserved portion of the Government cargoes. A policy achieving that end cannot be considered by any stretch of imagination as an unfair practice. It would on the contrary, strengthen the hands of all concerned to acquire additional tonnage for India's overseas trades and put Indian shipping on a more economic and more durable basis.

NATIONAL SHIPPING MUST BE ENSURED A SHARE

It is well-known that every enlightened maritime country today has been expanding and expanding rapidly its overseas tonnage. India cannot and should not remain impervious to the enormous benefits, which the nation would derive through the expansion of their shipping services for carrying, at any rate, a sizable portion of India's foreign trades. The Government should keep this question in their minds upper-most, while negotiating any bilateral trade agreement or entering into any contract for the sale or purchase of any goods. It was unfortunate that while making a contract for the sale of lakhs of tons of Ores to Japan, on f.o.b. basis, no arrangement was made for the carriage at least of a sizable portion of those Ores by Indian ships. Just imagine what a tremendous loss it would be to the foreign-exchange pool of India, if all the six million tons of Ores per year, were sold f.o.b. and allowed to be carried by the ships fixed for that purpose by the purchaser. That would mean that India will lose all opportunities of earning a large sum of foreign exchange which will be involved in the carriage of Ores to the tune of about Rs. 45 crores. It is necessary, therefore, that the Government should take the country into their confidence and give them a definite indication and a positive assurance as regards what they propose to do in matters of this nature.

With greater attention and deeper thought on the problems of Indian shipping, with the formation of a long-range policy, and the evolution and execution of well balanced and well evolved plans to implement that Policy without any delay, the economy of India can not only be strengthened, but the all round progress and development of the country will also be facilitated and assured. This very crucial and vital pre-requisite for India's economic regeneration needs to be kept uppermost in mind so that India can secure her rightful place a tan early date in the comity of Nations.

(By courtesy : "Transport")


India makes them...
...these coated rods of metal, so indispensable in the fabrication of ships and locomotives, penstocks and blast furnaces, trucks and railway coaches, pipelines and, structurals, that form the very foundation of our Second Five Year Plan. Ranking with Power and Fuel in importance, they are a vital tool for industry. In metal fabrication...
... there is an
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one terminal of an electrical equipment called welding generator or a welding transformer. The base metal is connected to the other terminal.

The electrode is generally a metallic rod covered concentrically along its length with a chemical material called "flux". One end of it is kept bare upto an inch or so, so that it can be held in the jaws of the electrode holder to carry the current to the other tip. When this other tip is touched to the base metal, withdrawn, and held a fraction of an inch away, an arc of intense heat is formed. This arc which has a temperature of about 6900°C, becomes a miniature furnace with two extremely hot spots, one on the electrode and the other on the work just under it. The portion of the work melts under intense heat and forms a small pool or crater and simultaneously the electrode also melts at the tip and deposits itself in the crater. As the arc travels further down the joint, the metal in the crater just behind the arc is solidifying into a dense joint. Obviously, feeding the electrode down all the time as it melts and maintaining the same arc length and its speed of travel call for skill on the part of the welder.

ADVANTAGES

Switching over from riveted designs to welded designs seems a far cry. It is not merely a matter of substitution but of complete reorganisation. Welders have to be trained, right types of electrodes have to be obtained, very often joints have to be bevelled for obtaining complete fusion and steps have to be taken to avoid porosity and cracks in welds and distortion of the assembled parts. Rigid inspection methods have to be laid down, right grades of steel have to be selected as higher carbon contents in the steels may lead to hardness and brittleness in the weld or in the heat-affected zones next to the weld, and high sulphur contents may cause porosity in the weld metal. However, advantages in favour of welding arc so overwhelming that any amount of organisational work is worthwhile.

The advantages of welded steel construction can be summarised as follows:

1. Welding decreases weight and cost of structural members which need not be weakened by rivet holes.

2. Saves material in structural connections by making them more compact, and in some cases, by eliminating connection materials altogether through the direct welding together of members or structural elements.

3. Saves cost in fabricating, fitting and assembly by eliminating operations of punching, drilling, countersinking, etc., and by reducing the amount of handling of heavy pieces in the shop; also provides greater flexibility to keep pace with other fabrication and erection operations.

4. Provides greater freedom in architectural and structural design, and better appearance (when steel work is exposed), because of smoother surfaces and outlines.

5. Facilitates economical and convenient alterations and additions to structures, with a minimum need for removal of existing walls, partitions, floors or other members and with no field drilling of holes for connections to existing members; also results in a minimum of noise and other inconvenience to occupants.

6. Reduces corrosion and cost of cleaning, painting and maintenance of exposed steel work, because of the smooth surfaces provided by welded construction, which prevent the accumulation of corrosive dust and other matter in the framing of powerplants and industrial buildings, and which discourage corrosion in coal bunkers and other coal handling equipment. Corrosion is generally

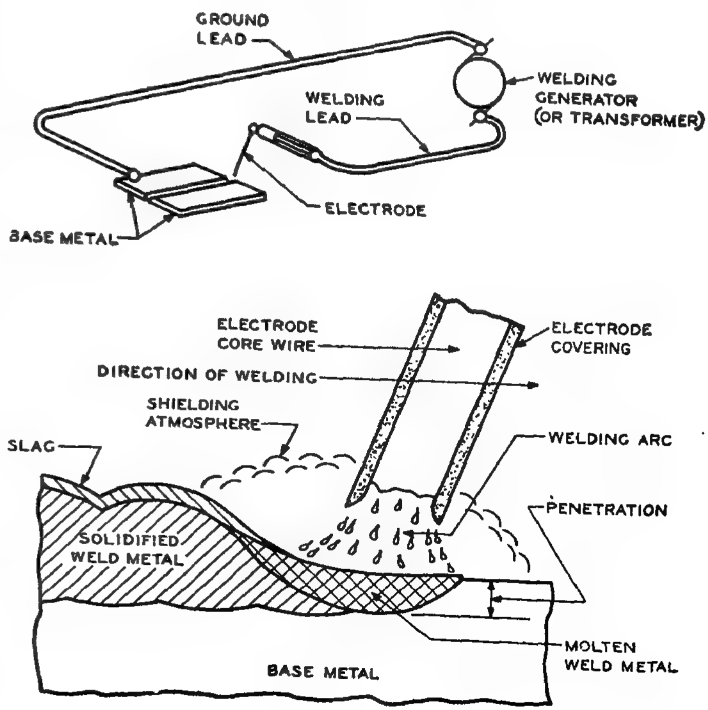


Fig. 1.

greater in rivets than in base metal, but welds are more corrosion resistant than base metal.

7. Eliminates leakage at joints in storage tanks, service piping, etc.

In order to obtain a more convincing picture of the superiority of welding or reveting in steel construction work, the following table is reproduced. It has been prepared by the Air Reduction Company of New York, from data reported for various examples of welded bridge and building construction:

Class of Structure.	Saving in Weight compared to riveted structure.
Rigid-Frame or Arched Roof Buildings, Auditoriums, Hangars, etc.	20—26%
Mill Buildings, etc. with Roof Trusses	10—15%
Industrial Handling Equipment	15—30%
Girder and Arch Bridges	15—30%
Truss Bridges	10—20%
Continuous Rolled Beam Bridges with cover plates, splices, stiffeners, etc.	10—15%
Conventional Tier Buildings	5—10%
CLASS OF MEMBER OR UNIT	
Truss-Type Bents for Mill Buildings	20—30%
Built-up Plate Girders	20—35%
Trusses	15—28%

OVERCOMING WELDING DIFFICULTIES

Changeover from riveting to welding requires some amount of forethought and caution because, to the uninitiated, welding presents a number of unforeseen difficulties.

During welding, steels are subjected to structural, dimentional, and compositional changes which have an important bearing on what is called weldability. First, in a process like arc welding, metal is melted and often must resolidify under conditions that are approximately the same as those encountered in chill casting. Second, the base metal adjacent to the weld is unavoidably heated momentarily to a maximum temperature that varies, with the distance from the weld, from the melting temperature of the steel to room temperature. Third, the temperature and phase changes taking place introduce in the weld volume changes which cause plastic flow and residual stresses and which may lead to cracking.

Again, structural distortion in one form or another is incident to all forms of welding, and if improperly controlled may be sufficiently severe to render the welded assembly nearly useless. It is caused by two factors: The thermal contraction or shrinkage of the weld metal on cooling from molten to atmospheric temperature and the different expansion and contraction of the metal adjacent to and affected by the heat of the weld.

Difficulties such as those described above have been successfully overcome by using weldable steels, applying preheat or postheat treatments wherever necessary, and by a proper sequence and procedure of welding.

POPULARISATION OF WELDING

Earlier, mention has been made of the work started by the Indian Standards Institution to popularise welding in India. For successful execution of this work, the I. S. I. has formed a welding sub-committee representing the electrode manufacturers, steel makers, welding inspectors, and leading designers and fabricators in steel. This Sub-Committee is bringing out a series of codes and specifications on arc welding electrodes and equipment, on arc welded applications such as bridges and pipelines. Courses are being prepared for the systematic training and testing of welders, and steps are being taken for the setting up of welding schools in the country. A series of hand books for the instruction of welders, welding supervisors, welding inspectors and welding engineers is being published.

FAITH IN WELDING

Faith in the efficacy of welding is an important requisite for its popularisation and faith cannot be born merely by the availability of published codes and handbooks. Thanks to the enterprising spirit of those in charge of such projects as the Integral Coach Factory and the Chittaranjan Locomotive Works, welding is being accepted and put to test on important fabrication jobs. Welding is being organized on many other projects. Hindustan Shipyards at Vizagapatnam are also organising a welding school in view of the growing use of this process in shipbuilding. All-welded Vaitarna-cum-Tansa pipeline in Bombay is a triumph of welding. Standard arc welding electrodes, equal to the world's best, are now

manufactured in India, and almost all these projects use exclusively. Indian-made electrodes. One enterprising electrode manufacturer has already introduced what are called "Low-Hydrogen" electrodes in this country which are specially meant for the fabrication of high tensile steels and these are already finding large scale application in the various projects like Perambur Coach Factory, D. V. C. etc. etc.

GOLDEN RULES OF CONDUCT FOR RAILWAYMEN

1. Do you plan your work daily? Get the more essential things done first and do not neglect the important ones sidetracting them to the fag end of the day.

2. Do not express casually careless opinion. Never venture forth an opinion unless asked for it.

3. Remember that most of our mental worries come either from trying to fight life hard or from trying to run away from life. Do neither.

4. Learn to accept people as they are, love them, respect them, praise them, encourage them, differ with them, but above all, learn the priceless art of give and take.

5. Cry neither for the moon, nor over spilt milk.

6. Accept the things that you cannot change; have the courage to change the things that you can, and possess the wisdom to know the difference.

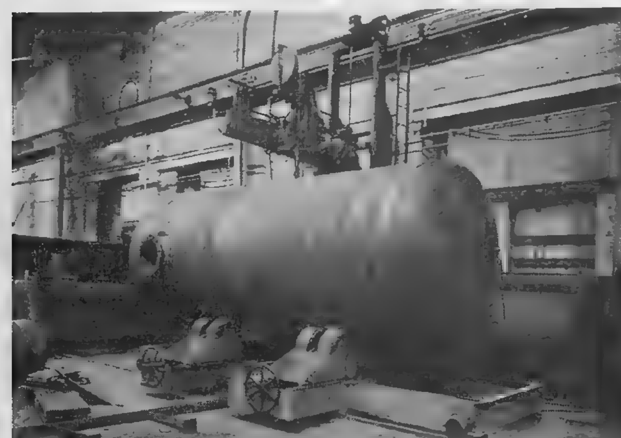
7. Do not drive too hard a bargain with yourself.

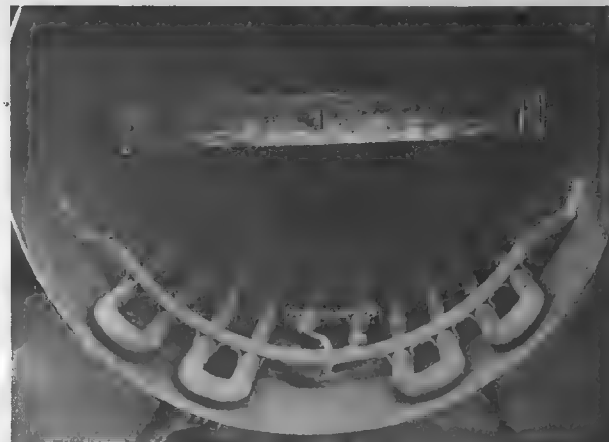
8. Accept life as it is—its wonders, changes, disappointments, frustrations etc., etc.

Specific Applications for Automatic Welding

WELDING is extensively used for many classes of fabrication on railway work. Among the more common are tenders, the underframes of carriages and the panel and roof assemblies, locomotive frames and boiler shells and fittings. There are also numerous applications for permanent way points and crossings.

A typical welded tanker for transporting liquids by rail.


A vessel in the course of fabrication. Here a FUSARC automatic welding head is mounted on a Universal type of cantilever and the vessel is mounted on a traversing roller bed. For welding the circumferential seams, the vessel is rotated. For welding longitudinal seams it is traversed on the roller bed under the welding head.


Internal heating pipes are welded in position.

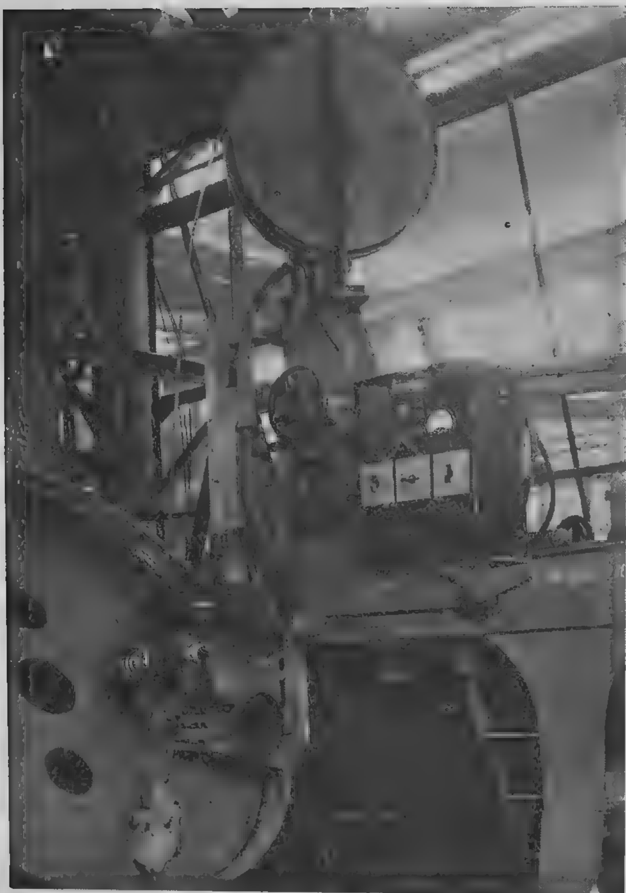
It is not proposed here to deal with all these applications in detail since most of them are quite usual applications of manual welding that do not essentially differ from other types of fabricated work.

There are, however, certain specific applications where automatic welding is being used to an increasing extent. One is the fabrication of cylindrical vessels which are used principally as the pressure vessels of locomotives themselves and vessels for bulk liquids to be transported by rail.

Such vessels are usually welded with a comprehensive automatic set-up which would usually consist of a roller bed above which is mounted an automatic welding head on a cantilever-type supporting structure, and, where the inside seams of vessels are also to be welded, an internal welder.

The vessel is mounted on the roller bed and can thus be automatically rotated at correct welding speeds for welding the circumferential seams. The rolls are adjustable for vessels of varying diameters. Motorized traverse can also be incorporated so that the roller bed can move at welding speeds along rails set in the shop floor in order to weld the longitudinal seams.

The welding head is mounted on a cantilever welding head manipulator, the platform of which can be raised or lowered for vessels of varying diameters. It may be stationary mounted or, where a stationary roller bed is used, may also have motorized traverse

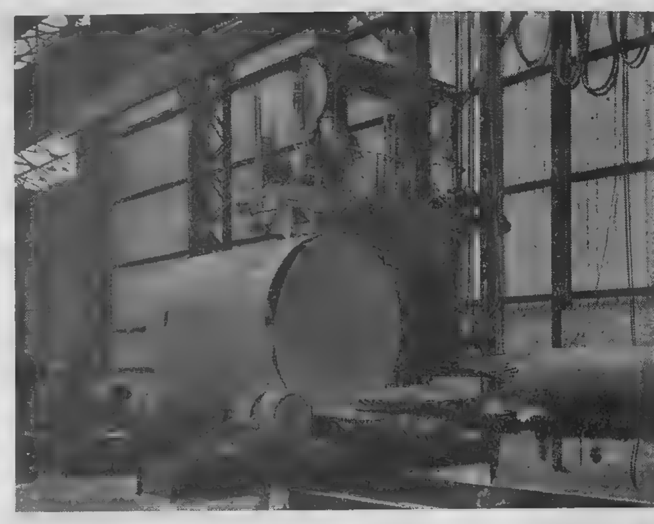


Wheels are rotated on a manipulator at 45° for fillet welding the discs to the rim. The FUSARC automatic welding machine is stationary, but for other applications may be traversed along the portal beam.

for welding the longitudinal seams. Some models of the cantilever also permit adjustment of the head outwards along the cantilever arm.

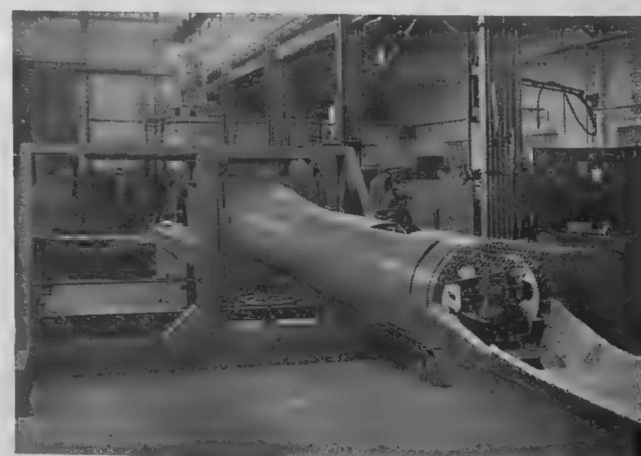
For internal welding, a welding head is fixed on the end of a slender boom. For internal circumferential seams the vessel is rotated on a roller bed at the welding speed, while the boom, within the vessel, is stationary. For welding internal longitudinal seams the roller bed may be traversing the vessel at welding speeds or the internal welder itself may be traversing.

There are several variations of this equipment. One is where the operator lies prone in a lay trough and observes the arc and the progress of welding through a dark-glass screen let into the base. In front of him is the control panel from where he has

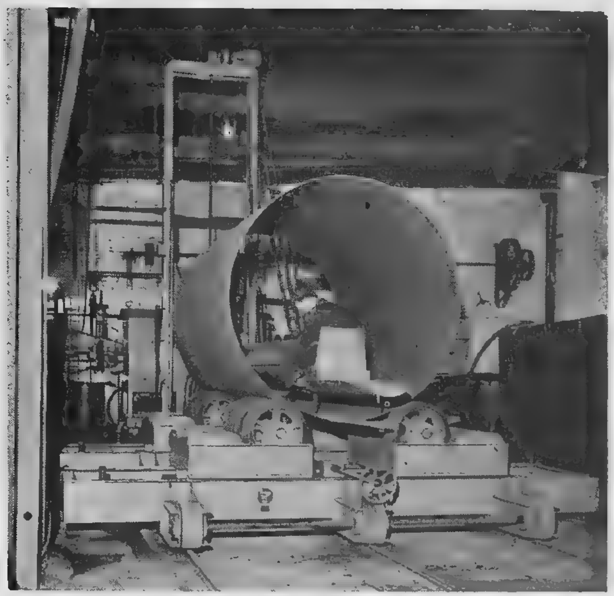


A comprehensive vessel welding installation. A FUSARC automatic welding head is mounted on a cantilever which traverses for welding longitudinal seams. The vessel is rotated on the roller bed for welding circumferential seams. A traversing internal welding boom is used for welding the internal seams.

local control over the welding and the traverse of either the internal welder, or, where this is of a fixed type, of the roller bed. Operator-carrying internal welding apparatus of this type is obviously limited to vessels with a minimum internal diameter of 2ft. Equipment for welding narrower vessels has, however, been developed without the need for an operator to be carried.

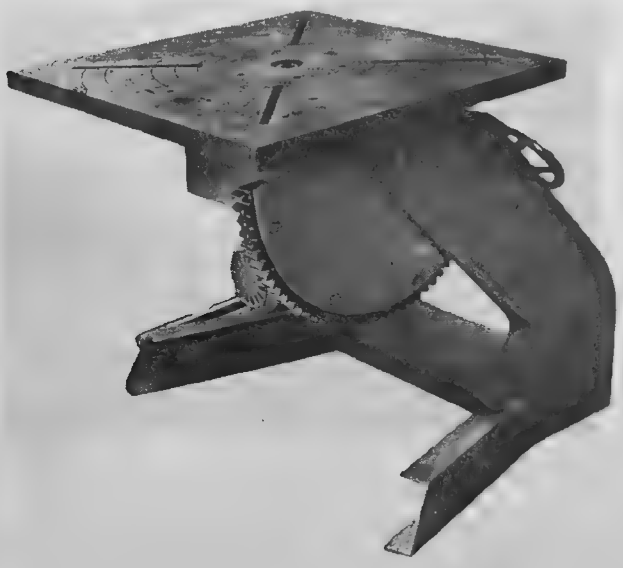


A fixed type of internal welding boom using a FUSARC automatic welding head. Provision is made for raise and lower of a few inches and for cross traverse for centering.

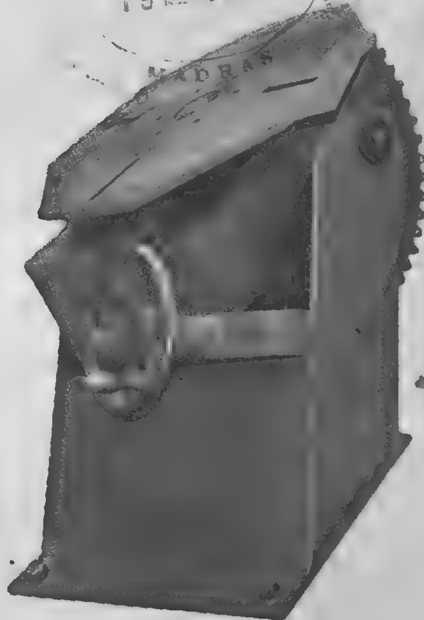


A high lift welding boom. This apparatus may be equally well employed for internal or external seam welding. The vessel is either rotated or traversed on a roller bed.

Another alternative, and one which combines, in some instances, the functions of the cantilever and internal welder is the high lift boom welder. This again comprises an automatic welding head mounted on the end of a slender boom but the boom is arranged for motorized raise up to 12 ft. 6 in. or



A 1 ton manipulator which has motorized rotation. The table can be tilted through 135°.



A 2 cwt. manipulator for positioning smaller fabrications. The table can be tilted through 135° and has motorized rotation.

lower within a vertical support. Here, again, two versions of the boom are available, one in which the operator is carried and the other not, depending on the diameter of work regularly encountered. The principal advantage with this type of equipment is, however, that it can be used both for internal or external welding of cylindrical vessels.

Roller beds are, of course, essential equipment for the welding of circumferential seams on cylindrical work, not only for speedy and efficient handling but especially where a constant speed of rotation is necessary—as it is where automatic welding heads are employed. Where motorized traverse is incorporated they can be equally well used for the longitudinal seam welding. There are three types of roller bed generally available these being light, (for weights up to one ton): medium, (for weights up to 24 tons): heavy, (for weights up to 100 tons). Idler units are also available to give either extra load-carrying capacity or to give additional support to obviate deflections in excessively long vessels. By the combination of either drive or idler units within each series the most flexible and versatile arrangement can be assembled to take vessels of varying weights and sizes.

Other manipulating equipment in use for automatic welding is the range of positioners and manipulators

designed to take loads between 1 cwt. and 6 tons. These are designed to position fabrications in the most convenient way for welding and to rotate them where necessary at welding speeds. A turntable is incorporated which tilts through 135° and which is rotatable. In most models rotation is by electric motor and this can be electronically controlled to give constant rotational speed even with eccentrically balanced loads.

Another useful item of equipment is the radial beam positioner. The beam on which the automatic welding head is located is adjustable in height and reach and can be locked in any required position. The whole beam and the supporting vertical column can also be rotated on its base. Thus it can be used where several different welding operations are necessary and all that would be usually needed would be to swing the beam carrying the welding head, over the required location.

The radial beam positioner. Most types of automatic welding heads can be mounted on this. The arm may be raised or lowered and can be extended outwards and the whole positioner can be rotated on its base so that the same welding head can be employed at several different adjacent locations.

Specialised welding machines can be built for many purposes. One distinct field for this in railway work are machines for building up worn components by depositing weld metal on the surface so that after final machining, the worn part is restored to its original dimensions. Another use in which the technique is identical in many respects is the depositing of hard surfaces to components that are subject to exceptionally hard wear as is frequently the case with railway stock. The descriptions of such typical installations follow :

WHEEL AND SHAFT REBUILDING INSTALLATION

The machine is used for rebuilding wheels up to 4 ft. diameter and shafts up to 8 ft. long. Typical items of the latter include brake shafts, dip rods, brake cross stays and intermediate buffers. These vary in diameter between $1\frac{5}{8}$ in. and 4 in. and can be mounted between centres using a head and tailstock. The bearing surfaces are first roughly turned, and then built up with weld metal, being finally turned to finished size.

The installation comprises a welding machine

Wheel and shaft rebuilding installation used for items such as brake shafts, dip rods, brake cross stays, intermediate buffers. The turntable rotates the workpiece and the FUSARC automatic welding head traverses the length of the machine so that the weld metal is deposited helically and evenly on the surface of the component.

consisting of a FUSARC automatic welding head on a traversing carriage. This is propelled along the runway of a beam approximately 13 ft. 6 in. long by means of a lead screw. Thus the shaft is being rotated and the welding head traversed at the same time so that the weld metal is deposited helically on the surface of the shaft.

One of the supporting columns carries a tilting turntable suitable for supporting a wheel 4 ft. in diameter. This can be tilted through 90° and also raised and lowered by handwheel for appropriate welding heights.

When this turntable is tilted to the vertical position it forms a headstock which, together with a tailstock at the other end of the machine, is used to support and rotate the shaft. The tailstock is adjustable to accommodate shafts of various lengths.

A change speed gear box is provided so that the rotation of the turntable is locked with the traverse of the welding head to maintain a continuous weld.

General Data for work of this nature, using NOR-MEC electrode is as follows :—

Diameter (ins.)	Current (amps.)	Electrode Gauge	Forward Travel per. rev.	Rotary Speed of job in revs. per. sec.	Arc Voltage
$1\frac{5}{8}'' - 1\frac{3}{4}''$	120	$\frac{10}{12}$	$\frac{3}{16}$	40	25
$1\frac{3}{4}'' - 2''$	120	10	$\frac{3}{16}$	45	25
$2'' - 2\frac{1}{2}''$	150	8	$\frac{1}{4}$	63	25
$2\frac{3}{4}'' - 3''$	200	6	$\frac{1}{4}$	68	25
$3'' - 4''$	200	6	$\frac{1}{4}$	83	25

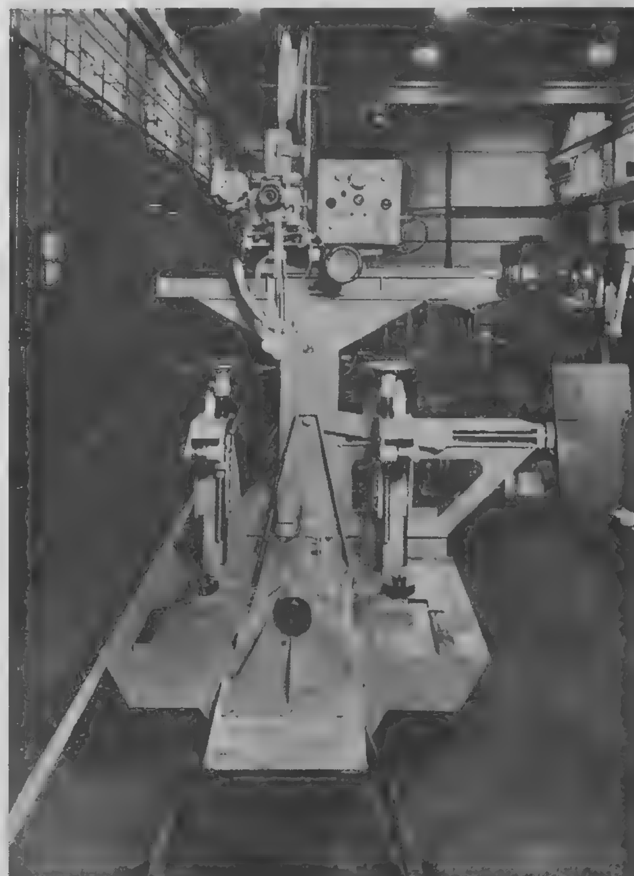
On smaller diameter work the welding current is lower since overheating of the workpiece would occur at higher currents. The speed of rotation is also slower for the smaller diameters since the weld deposit would tend to run away at higher speeds.

The depth of deposit is approximately $\frac{1}{4}$ in. with the first run and $\frac{3}{16}$ in. on succeeding runs. Two runs are, of course, usually sufficient for building-up most classes of work.

The same equipment may also be used for the rebuilding of grooves and edges of piston heads and the rebuilding of the inner faces of bogie wheels.

WHEEL TYRE REBUILDING

The railway wheel tyre rebuilding installation is designed for rebuilding tyres where the wheels remain on the axles throughout the operation. In the U. K. this is used only for welding wagon wheels, where the carbon content is in the order of 0.4%. It is not practicable to weld locomotive wheels since they have a higher carbon content and are prone to cracking. FERROMEC continuous covered electrode is most suitable for welding wagon wheels and the welding speed would be 6 in. per minute at 350 amps. and 20–22 arc volts. The welding time for one layer would thus be 20 minutes. The minimum thickness of tyre



Wheel tyre rebuilding installation. The wheels remain on the axles throughout the operation. The lower part of the machine comprises a bed which may be tilted in either direction so that the welding nozzle may be applied at the correct angle to the flange of the wheel.

(N.B.—The machine here shown is a demonstration set-up on trestles : in practice the tilting bed would be sunk within a pit and the wheels would be rolled onto the bed on rails laid in the workshop floor.)

which can be welded is 1¾ in. and, since most tyres take four layers to complete the build-up, the total welding time per tyre would be 1 hr. 20 mins.

The machine illustrated on page 5 is suitable for wheels having a gauge of 3 ft. 6 in. and a range of diameter across the thread from 700 mm. to 1000 mm. It comprises a vertical column carrying a runway along which traverses an automatic welding head. The carriage carrying the head can be traversed by a handwheel for positioning the head correctly in relation to the wheel.

The lower part of the machine comprises a bed which swings by means of pivots. It may be tilted in either direction and the welding head can be applied at the correct angle to the flange of the wheel. The tilting action is operated through a worm and worm-wheel by a handwheel. The tilting bed is provided with two hardened drive rolls which are rotated by a variable speed geared motor unit to give a welding speed range of 5 in. to 20 in. per minute. The speed variation of the rollers is controlled from an instrument panel incorporated with the welding head.

In operation, the wheels on their axles are rolled onto the bed from tracks which would be laid in the workshop floor. After positioning on the tilting bed they are located by adjustable rollers which engage with the axles.

ADVANTAGES OF AUTOMATIC WELDING

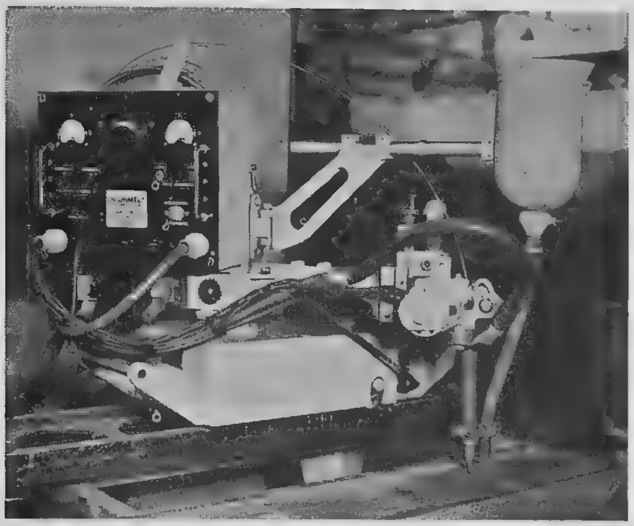
There are several automatic welding processes in general use but they all have certain features in common. The principal advantages of automatic welding are, firstly, much faster actual welding speeds are possible since much higher welding currents can be used than is possible with manual welding. Currents up to 2000 amp. are increasingly being used with automatic machines. Secondly these automatic processes all employ continuous electrode which permits a greater duty cycle. Welding for long periods is possible uninterrupted by the changing of electrodes. Thirdly, by the use of higher welding currents, deeper penetration is possible and the number of passes required is greatly reduced. This deep penetration also means that less edge preparation of the plate is usually required. In addition to these major advantages is the reduced distortion due to its speed that is a feature of automatic welding and the smoothness of the welds means that less finishing is required. All these points combine to mean that the ratio of actual welding performed to total time spent on the job is enormously increased.

The smoothness of automatic welding is achieved by the way in which the arc length is kept completely constant. The means of this constancy, despite variations in welding current, plate undulations and other irregularities is somewhat complex and differs slightly with the various processes but the result is the same, and smooth, consistent, high quality welding is assured.

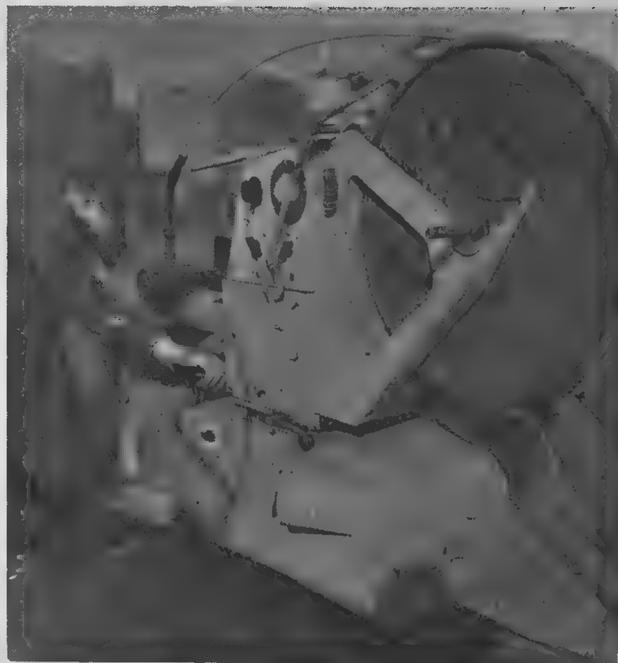
In the UNIONMELT process, the submerged arc principle is used whereby weld metal from a continuous bare wire electrode is deposited through a blanket of powder which acts both to protect the molten metal from atmospheric contamination and as a fluxing agent. Some of this powder fuses during welding to form a slag which easily peals off the weld when cool. There are thus no losses by spatter and vaporisation and, as the arc is submerged, no protective accessories are required.

The FUSARC process is an open or visible arc method. The continuous electrode comprises a core wire surrounded by a number of helically opposed auxiliary wires into which the flux is extruded. A recent development is the FUSARC/CO_2 process in which the welding head is basically the same and the same type of covered electrode is used. In conjunction with this, however, a shroud of carbon dioxide gas is used to give additional shielding of the arc. The combination of flux and gas shielding allows further increased welding speeds. An outstanding feature of this process is that high-quality horizontal-vertical fillet welding can be

A FUSARC automatic welding machine making horizontal-vertical fillet welds. The fabrication is positioned at the correct angle and the welding head traverses along the beam.



A UNIONMELT self-propelled welding machine. This is particularly useful where long straight lengths of weld deposit are required. For other applications, the machine may also be used stationary and the workpiece manipulated.



A FUSARC self-propelled welding machine. No track is required with this machine, since it is fitted with car-type steering, the operator merely guiding the machine along the joint.

performed very rapidly. Great depth of penetration is possible and, just as important, an extreme degree of control can be exercised over the penetration; the process can thus be equally well employed on thick or thin material.

The other principal method of automatic welding is SIGMA where a bare wire electrode of comparatively thin diameter is used. The arc and weld metal are protected from contamination by a shield of inert gas, largely or entirely argon. Extremely fast welding speeds are possible and this results in the minimum of distortion. No fluxing agents are used and de-slagging is thereby eliminated. The welds are to the highest radiographic standards with a clean, smooth appearance and may be painted immediately the metal is cool. Most metals over 16 gauge and aluminium down to 18 gauge can be successfully welded by the SIGMA process.

Automatic welding heads of all the foregoing types, of course, need to be used in conjunction with automatically controlled relative movement between the welding head and the workpiece. This, in fact, provides the welding speed and the movement may be achieved, as was mentioned earlier, by rotating or traversing the workpiece on some form of mechanical manipulating equipment. Alternatively the work may be kept stationary and the welding head itself may be traversing. Where it is built into a machine it may be propelled at the required speed through a lead screw. It may be preferable for certain applications, particularly where long straight welding runs are required, to have a portable self-propelled welding machine into which the welding head is built. In the case of UNIONMELT welding heads these may be incorporated in a tractor which travels along a length of track which is aligned with the seam. FUSARC and FUSARC/CO_2 welding heads may be built into machines, that require no track, but can have car-type steering so that the operator merely guides the machine along the seam. These too, however, may, if necessary, be adapted for running along a track.

The choice of the type of equipment required will, of course, depend on many factors; a principal one being the amount and frequency of any particular class of work.

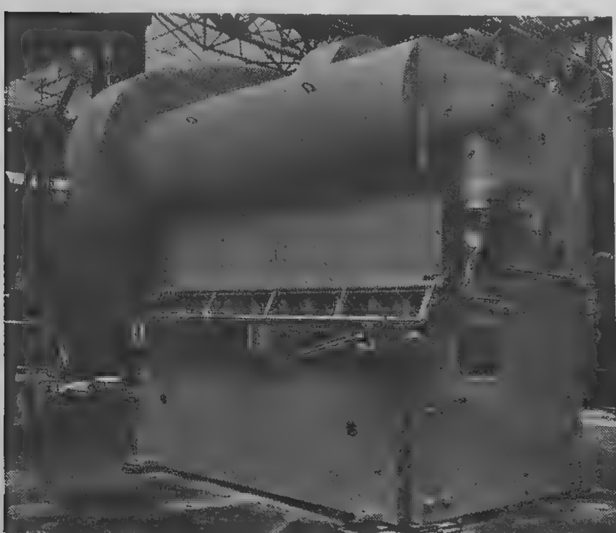
Scottish Machine Tools for Railway Workshops

[Scottish Machine Tool Corporation are represented in India by Rallis India Limited.]

SCOTTISH Machine Tool Corporation continue to maintain their close association with Railway Workshops both in India and elsewhere. Among the recent developments which they are now offering for sale are fully automatic profiling attachments for heavy Wheel Lathes using tungsten carbide tooling and high speed rail planing machines of exceptional strength and power designed to utilise tungsten carbide tools.

Among some of the more interesting contracts recently obtained from the British Railways in connection with their modernization programme has been one for supplying approximately half of a large quantity of Axle Journal Re-Turning Lathes fitted with grinding heads. These machines will be employed exclusively in the conversion of axles intended for plain bearings to be suitable for mounting the roller bearings which are being generally adopted now through British Railways. The Corporation are also building a batch of standard Railway Planing Machines for a Central Railway Shop and these Planers are provided with speeds up to 120 f. p. m.

LOUDON Rear View of 6′-3″ Locomotive Wheel Lathe



Bennie 8′ × ½″ Guillotine Shearing Machine

Owing to the diversity of the range of machines built by Scottish Machine Tool Corporation they are also able to provide a variety of other machines in connection with rail working such as rail curving rolls, fishplate punching machines and heavy duty bearing plate punching and cropping machines while for carriage and wagon works they can also supply guillotines, gang punching presses for working on the coach frames, press brakes and plate folders, notching machines and spring plate finishing presses for the cold working of spring laminations. This last machine has been supplied to a number of Indian Railway workshops where it is achieving valuable economies by eliminating the expense of heating the spring steel bars and by making simpler handling possible. Other machines recently delivered to the Indian Railways include an Axle Journal Lathe for working with mounted locomotive wheel sets and a heavy duty wheel lathe having 6′—0″ diameter faceplates.

Role of Asquith Machine Tools in Railway Workshops

THE range of machine tools manufactured by member companies of the Asquith Machine Tool Corporation includes many machines applicable to the construction and maintenance of railway locomotives, rolling stock and equipment.

Asquith O. D. Type Radial Drilling Machines are to be found in railway workshops all over the world. These machines are made in a wide variety of sizes up to a maximum radius of 12 ft. and capacity to drill from the solid in mild steel up to 5 in. diameter.

Asquith Radials are well-known for their high productive capacity and a design aspect which contributes to this advantage is the grouping of controls for convenience of operating and for visual as well as manual simplicity.

The O. D. 1 Type Radial has a nominal drilling capacity of up to 3 in. from the solid in mild steel. A range of 12 spindle speeds is provided and 4 spindle feeds are available as standard. If required, a 6-feed box can be supplied.

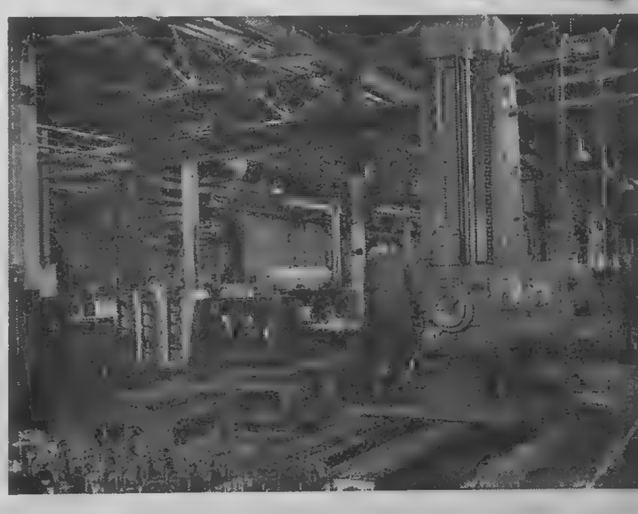
For tapping operations reverse to the spindle is obtained electrically, eliminating mechanical clutches with their incidental conditions of wear and adjustment. The efficiency of this principle is demonstrated in the works of many users where quite often twenty reversals a minute are made continuously on production operations.

Anti-friction bearings are introduced wherever they can be usefully employed on O. D. Radials and a highly efficient system of lubrication is another feature which contributes to the long, accurate, trouble-free operating life of the machine.

Another Asquith Radial which is widely used for railway applications is the Structural and Plate Drilling Machine, type E. G. C. This may be regarded as a simplified version of the O. D. Radial, specially designed to provide structural engineers with simple, fast, holemaking equipment. This machine is available with a variety of mountings such as traverse bed for drilling loco frames, large structural members, etc.; bogie base for plate drilling; box bed for general purpose work, etc. Drilling capacity of the machine with three speeds, is up to 2 in. from the solid in steel. If required, 12 speeds can be provided and a capacity of 3 in. in steel is then possible.

Machines of particular value for repair work and for holemaking in large workpieces, are the Asquith Portable Universal Radial Drilling Machines. These are designed so that the machine can be brought to the work and positioned as required. This type of Asquith Radial is made in two types. The smaller capacity machine, which drills up to 2 in. from the

A double line of DRUMMOND "Maximatics" employed for crankshaft turning for diesel engines.



ASQUITH H. R. G. 4" Spindle Horizontal Boring Machine, set-up to work with three worktables.

HOW TO RESERVE ACCOMMODATION

Unless you reserve your berth (I Class) or Seats (II and 3rd Class long distance) in advance, you may not be sure of getting accommodation on the train you wish to travel by.

Application should be made to the Station Master of your starting station at least 3 days in advance specifying the date and train by which you intend travelling and the tickets must be bought in advance. The reservation fee leviable is 8 Annas per seat or berth.

Reservation by I and II Class from intermediate stations by Express trains can also be made similarly, but reservation ticket can be issued only after getting an advice from the Reservation Centre that the reservation has been made.

Tickets will be issued only if accommodation is available.

If the reserved seats or berths are not occupied at least 5 minutes before the booked departure of the train the reservation will be cancelled and the seat or berth given away to another.

Reservation fee is not refundable.

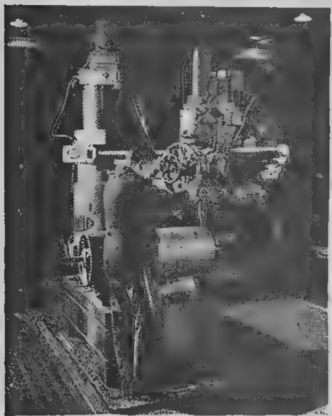
III Class seats are also reservable on Express and certain other important trains for long distance passengers from the train-starting stations on payment of a reservation fee of 4 Annas per seat.

Do not occupy a berth or seat reserved for another, as you are liable to be displaced at the last moment.

If you find another person occupying the berth or seat reserved for you and if he will not vacate it on demand, report it to the Guard or Station Master. They will help you.

(Inserted in the interests of Travelling Public)

solid in steel, is provided with bogie bed allowing horizontal traverse to the column on the bed itself, which has wheels and screw jack supports to take the weight when drilling.



ASQUITH O. D. 1 Radial Drilling Machine, drilling a drum.

ASQUITH E. G. C. Radial Drilling Machines drilling large girder for structural engineering.

The larger type of machine for drilling up to 2½ in. from the solid in steel, has a radius of 7 ft., and a bed giving 5 ft. 6 in. horizontal traverse is supplied.

Horizontal boring is another field of railway engineering where Asquith machines figure prominently. A very wide range of types and sizes of Asquith Horizontal Boring Machines is manufactured and covers every requirement. In fact, the latest Asquith machine of this type is one of the largest in the world, with a 10 in. spindle and 100 h. p. spindle driving motor.

The H. R. G. machine is a popular general engineering machine with 4 in. spindle. All operating controls are grouped on the front of the spindle slide, and a good selection of speeds and boring and milling feeds is available.

Machine tools manufactured by Drummond Bros. Ltd., Guildford, of interest to railway engineers, include Gear Shaping Machines, Automatic Multi-tool Lathes and Copy Turning Lathes. With the increasing employment of diesel traction, machines for gear cutting and crankshaft turning are of growing interest.

The Drummond " Maxicut " No. 3A Gear Shaper is essentially a heavy duty machine for cutting spur and helical gears up to 18 in. pitch dia. by 3/4 diametral pitch.

A 3 h. p. motor mounted in the base casting at the rear of the machine provides the main drive by vee belt to the gear box. Stepped pulleys enable two speeds to be obtained, and these, together with speed changes from the gearbox, permit a choice of eight speeds.

SWIFT Lathes turning ball joints in a British locomotive works.

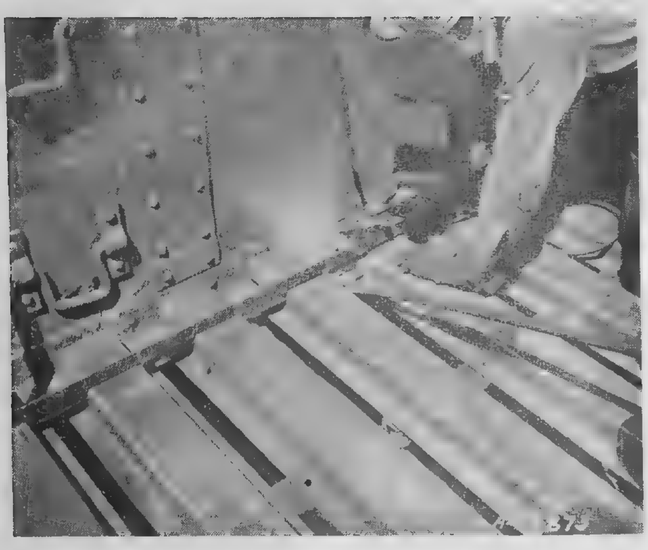
Drives are taken from the gear box to the cutter reciprocating crank and to the feed control box. Two cams on the main drive shaft operate the relieving mechanism.

The feed motions are direct to the cutter spindle and through pick-off gears to the work spindle, enabling them to rotate in unison according to the gear being cut.

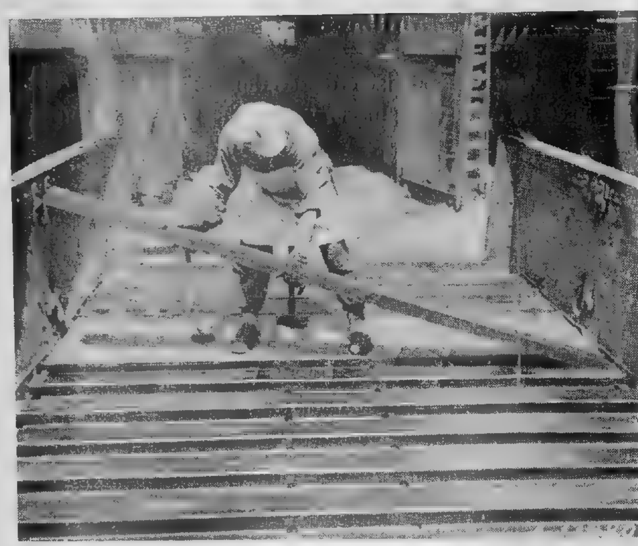
When setting the machine, the required speed and feed are quickly obtained with direct-reading hand wheel selectors.

Non-productive time has been reduced to a minimum by the design features of the No. 3A " Maxicut ", and it has proved ideal for the production of various types and sizes of gears in batches, as well as for long-run high-output production.

Drummond " Maximatic " Automatic Multi-Tool Lathes are essentially high-production machines and

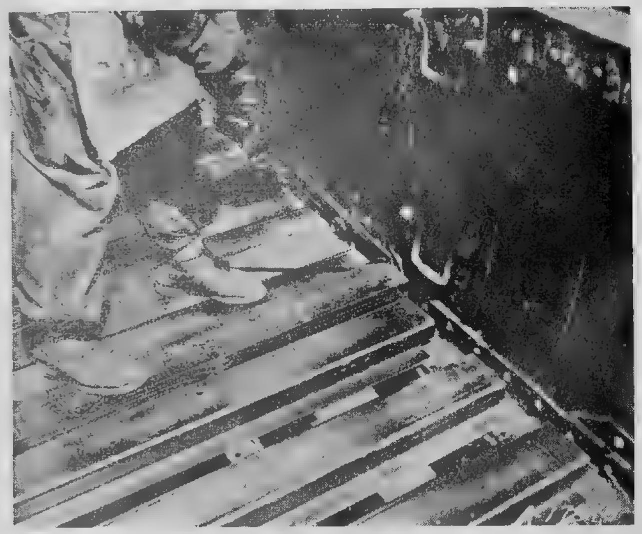


Tack welding Armco ribs while spaced with template. Note special pinch bar for holding ribs tightly to side sill while welding.



Laying treated wood planks between spray-painted ribs.

Welding special ribs over bolster.



Centering wood planks with pinch bar. Note chalk marks on steel ribs and car sides to locate bolt holes.

Welds are made on both sides of the ribs, two at center sill and two each at stringers and side sill angles. Resistance of the car underframe to twisting and racking is increased greatly by this strong welded lattice.

A SOUND INVESTMENT

The life of an ordinary wood-plank floor is limited to an average or about five years. The Armco floor will last much longer. It's steel ribs should be good for the life of the car.

The wood nailing strips are not required to resist concentrated loading or heavy impact. That is the function of the steel ribs. The wood planks wear chiefly from abrasion, and from this they are partly protected by the top section of the steel ribs.

This protection of the wood plank from mechanical damage is favorable to the use of wood preservatives. They will extend plank life.

Drilling planks to match existing bolt holes.

Armco freight car floors help create satisfied shippers, reduce costly claims for damage and loss. The danger of heavy concentrated loads breaking through a weakened car floor and causing a serious accident is eliminated.

Armco freight car flooring will also reduce shopping time and consequent loss of revenue from out-of order cars.

DESIGN DETAILS

Sketch 1

Sketch 1 gives dimensions of standard gondola car ribs and planks. Method of bolting wood plank to side sills and stringers shown at left is used when existing bolt holes match wood planks. At center is bolt with floor clip, another method of fastening wood plank. At right is an Armco steel plank used over bolsters and cross-bearers where it is not practical to bolt wood planks.

Sketch 2

This drawing shows how steel ribs are welded to side sills, stringers and center sill. The arrangement shown to left of center line is used in older cars. Here, a steel filler strip is welded to the center sill and the steel ribs in turn are welded to the filler strip.

Drawing indicates how wood planks are fastened by bolts through side sills and stringers as previously shown in Sketch 1.

This box car installation uses floor clips similar to type shown in Sketch 1, to fasten wood planks to steel ribs and stringers.

Pouring car cement after inserting galvanized closure strip and filling crevice with sawdust.

The arrangement to the right of centerline of car shows the half-section of center sill used in newer cars.

finished they grip the next piece, while simultaneously the wheels of the machine open again to allow the ground piece to be ejected, thus completing the cycle.

One of the main advantages of the method is its versatility, as a mere change of the removable jaws enables it to be used for a wide range of pieces differing widely in characteristics, such as the types shown by Fig. 3, all of which present certain difficulties for loading by a normal push feed. The piece "A", for instance, has a square shape (diameter and length approximately equal) which is always troublesome to locate or handle automatically; "B" has a head which would rule out the possibility of rolling it into position into the path of a push feed; "C" which is a multi-diameter piece, when handled by the swing-over method, is laid on the workplate with the large diameter slightly over the edge of the workplate clear of the wheels, and is fed forward into position by the so-called "plunge-and-run" process of centreless grinding, the piece being fed into position by the pulling action of the tilted control wheel.

On pieces of the types shown, assuming a stock removal of some .004" and a tolerance for size and roundness of .0002" the normal setting is a 10-second cycle.

GOLDEN RULES OF CONDUCT FOR RAILWAYMEN

1. Do you plan your work daily? Get the more essential things done first and do not neglect the important ones sidetracting them to the fag end of the day.
2. Do not express casually careless opinion. Never venture forth an opinion unless asked for it.
3. Remember that most of our mental worries come either from trying to fight life hard or from trying to run away from life. Do neither.
4. Learn to accept people as they are, love them, respect them, praise them, encourage them, differ with them, but above all, learn the priceless art of give and take.
5. Cry neither for the moon, nor over spilt milk.
6. Accept the things that you cannot change; have the courage to change the things that you can, and possess the wisdom to know the difference.
7. Do not drive too hard a bargain with yourself.
8. Accept life as it is—its wonders, changes, disappointments, frustrations etc., etc.

★

A Locomotive with Diesel-Pneumatic Transmission

Swedish-built Unit on the Geislinger Principle

AKTIEBOLAGET Motala Verkstad, established in 1822 and now belonging to the large Axel Johnson organization,* is one of Sweden's dominating engineering works. It built its first locomotive in 1861 and is since then one of the country's largest locomotive manufacturers. A couple of years ago the works delivered a loco. of new type to the Stockholm-Nynas Railway Company in Sweden.

The transmission system in this locomotive was carried out under licence from Doktor L Geislinger's patent. As shown by the adjoining picture the loco. is of type 1D1 with centrally arranged cab with two driving positions. In the front portion of the locomotive is located the cooling apparatus, whilst the engine is installed behind it, followed by the gearbox. Compressor and turbine are mounted on this gearbox. The total weight of engines, gearbox, compressor, turbine, combustion chamber and auxiliaries is 11.4 metric tons.

In the loco., the engine has 16 cylinders and is constructed by Hedemora Verkstæder, also belonging to the Johnson group, under licence from S. E. M. T.—Pielstick. It is a four-stroke engine of the pre-combustion-chamber type (bore 175 mm., stroke 210 mm.); normal output is 1.060 b. h. p. between 1.000 and 1.400 r. p. m. Features of the design include welded-steel engine frame, four-valve cylinder heads, manifolding within the vee between the cylinder banks, separate water pumps for (a) jacket circuit and (b) charger cooler and oil coolers. The engine is three-point mounted in the loco-frame, with fan air compressors at its "free" end. Two flexible couplings are used between the engine and gearbox.

The gearbox connects engine, compressor, turbine and transmission shafts. The differential and the planetary gearing are of Stoeckicht patents. The differential is driven from the engine through a speed increasing gear.

Reducing gear on the turbine side is arranged symmetrically to the differential; it reduces the turbine speed in the ratio of 7.93 : 1.

On the output shaft are arranged two disc couplings giving change from first to second speed. Passing from the first to second speed, for instance, fuel injection in the engine is first reduced to zero; when the engine slows down the first speed is disengaged and the second engaged. Only when the second speed is completely engaged is the injection gear returned to normal working. Special measures have been taken to ensure smooth gear changes without shocks. It is possible to change gear quite automatically as a function of the normal running speed. Drive to the axles is taken symmetrically on each side, using cardan shafts.

Compressor and turbine were constructed by Brown Boveri and Co., of Baden (Switzerland). The two groups are developed from a normal turboblower; all essential parts such as compressor and turbine rotors, inlet housing and outlet of turbine, have undergone no modification. The air conduit from the

compressor is divided into two branches. One portion of this air passes through the air cooler and pressure-charges the engine; the remainder passes to the combustion chamber and thence into the turbine.

Now we turn to the general operating principles of the design. The output of pneumatic transmissions increases considerably if the heat contained in the exhaust gases of the engine is utilized. Moreover, it is of advantage to combine the pressure-charging of the Diesel engine with the pneumatic transmission, so that part of the compressed air is absorbed by the engine. In fact, the output of an air compressor absorbing the whole power of a Diesel engine is much in excess of the amount of such air taken in by the engine, especially if the engine is of the four-stroke type and the charging pressure does not exceed from 14.2 p. s. i. to 28.4 p. s. i.

At high loads the charging pressure increases automatically if the engine speed decreases.

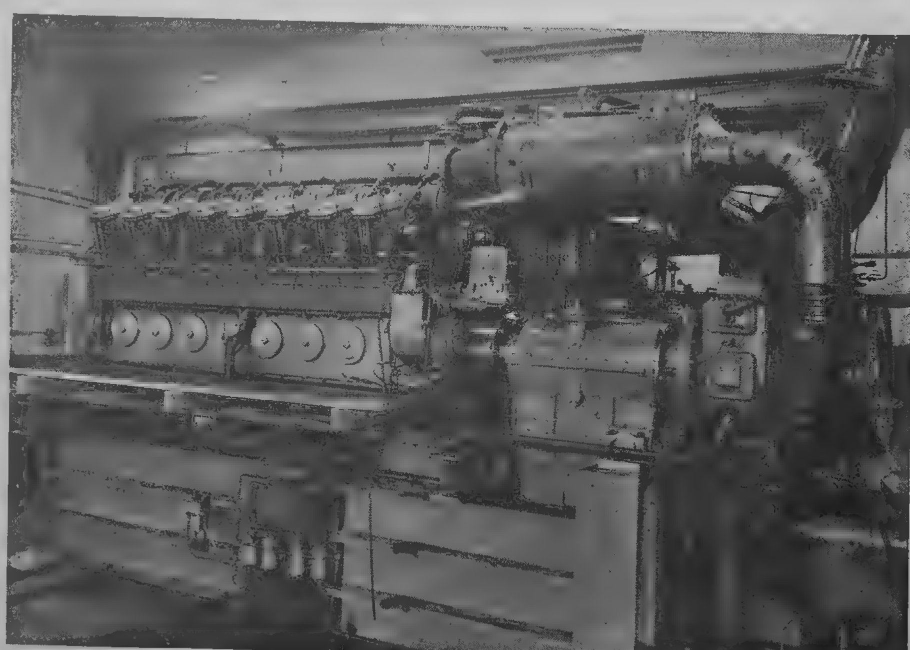
Development tests have shown, on the other hand, that a four-stroke Diesel engine works without difficulty against a back-pressure in the exhaust manifold equal to the charging pressure; in this case the engine can be considered as a non-pressure-charged engine working in a high-pressure atmosphere. With this method of working it becomes possible to mix the exhaust gases with that portion of compressed air not taken in by the engine; this mixture then passes into the turbine. The heat contained in the exhaust gases is thus recuperated, and increases the output of the transmission decisively.

Greater efficiency and output can be achieved if only a portion of the power developed is absorbed by compressor and turbine, providing one succeeds in transmitting to the driving wheels of the vehicle the remainder of the engine power without noticeable loss. The distribution of the power through a differential gear allows this idea to be realized. Such mode of transmission is known and is in use with hydraulic systems.

The general arrangement is shown in the accompanying diagram. The Diesel engine (1) drives through a speed-increasing gear (2) and (3) the planet-carrier (6) of the differential (4) Pinion (5) drives the compressor (11) The crown wheel (7) of the differential has two sets of gear teeth; the inside ones engage the planetary gear wheels, the outside ones engage the gear wheel (8) fitted on transmission shaft (10). The latter drives the rail wheels of the vehicle. A portion of the engine output is thus absorbed by the compressor and the remainder transmitted to the vehicle driving wheels. By means of a reducing gear (8, 9) the turbine (12) transmits power to shaft (10) already referred to.

Part of the air delivered by the compressor (11) is discharged into the inlet manifold (16) of the engine, passing through the air cooler (14). The remainder of this air passes into the combustion chamber (15). The increase in temperature of the air in this chamber gives a considerable power augment. The exhaust gases from the engine pass from the exhaust manifold (17) into the same chamber (15) where they mix with that part of the air not used in pressure-charging the engine.

By means of the differential gearing it is possible to transmit part of the engine power direct and without loss in conversion to the driving wheels at a high degree of efficiency. This division of driving power

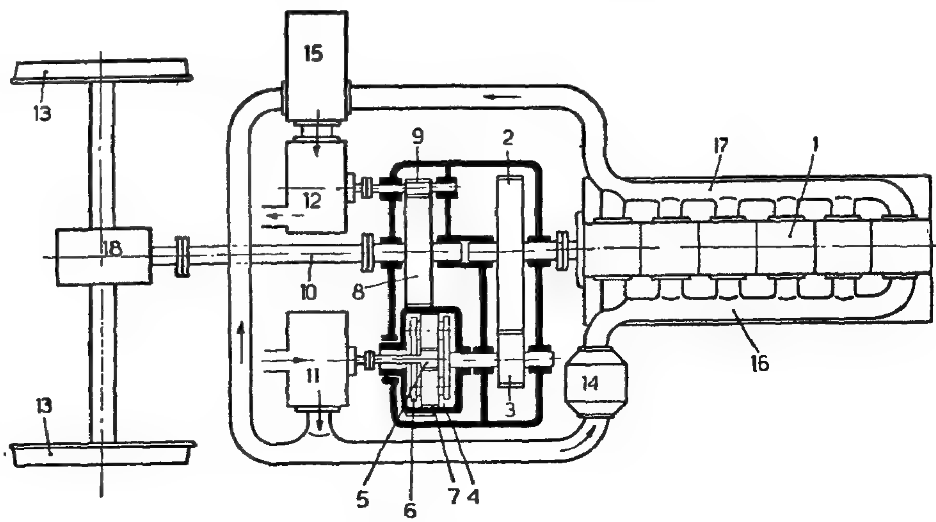


improves the efficiency of the Diesel-pneumatic transmission.

HEAT EMPLOYMENT

Let us suppose that at a given speed, 50% of the power is transmitted direct and the remainder absorbed by the compressor; the compressor then delivers half the quantity of air it would do if the power were not thus divided. The heat contained in the exhaust gases, on the other hand, does not vary. Since the weight of the gas plus air is only one-half, before the turbine entry is much increased, temperature i. e. there results, finally, an increase in the power developed by the turbine and a considerable increase in efficiency of the transmission. The power of the turbine can be possibly higher than that absorbed by the compressor, i. e., transmission efficiency exceeds 1; this is a definite advantage compared with all known transmission systems. This result is due, partly, to the fact that the useful heat of the exhaust gases at the supercharging pressures referred to is well over 40% of the heat contained in the fuel.

The temperature of the mixture of gas and air passing through the turbine is relatively low and only reaches 320°C at full load of the engine. This temperature can be raised by injecting fuel into the combustion chamber. The power of the turbine is proportionate to the absolute temperature of the exhaust gas. This increase of power involves an increase in the specific consumption. Notwithstanding this, the power applied to the driving wheels is about 10% higher than that developed by the engine, taking into account the power required for driving auxiliaries. With all other transmissions this (driving) power does not exceed 75% of the engine power. Increase in specific fuel consumption is hardly more than 10% over that with other forms of transmission. At from 2/3 to 3/4 loading, i. e. the most important state for locomotives, consumption related to power of driving wheels is better than that with other forms of transmission.



Tests of the combination of engine, gearbox and combustion chamber took place at the works of Hedemora Verkstader. The power developed was absorbed by a water brake and measured the optimum consumption to approx. 190 gr. (0,41 lb.) per h. p./hour; from this it follows that losses in gearbox, compressor and turbine are low. With normal turbo-blower the engine consumption is 170—175 gr. (0,37 to 0.38 lb.) per h. p./hour at the same loading. The power delivered by the gearbox output shaft, without the combustion chamber in operation, is from 900 to 940 h. p. at speeds of from 50 to 90 km./hour (31 to 55 m. p. h.).

Summing up it can be stated that without the combustion chamber in operation the output of this transmission, from the points of view of power and fuel consumption, is slightly better than with electric or hydraulic transmission. With the combustion chamber in operation the power transmitted to the wheels of the loco. 10% higher than that of the Diesel engine itself.

As to the power at wheel rims, this locomotive corresponds to a Diesel loco. of 1,400 to 1,500 h. p. with either electric or hydraulic transmission. One of the main advantages of this new loco. is the low consumption at moderate loads, viz. 60—80% of full, whereas the consumption at full load is slightly higher than that of a corresponding Diesel loco. with either electric or hydraulic transmission but considering that full load is seldom used, this point is of small importance. Aktiebolaget Motala Verkstad is now building a somewhat larger four-axled bogie locomotive on the same principle for the Swedish State Railways.

Indian Railways Third Class Sleeping Coaches

By A. C. Bhattacharya, A. M. I. P. E.

THE Indian Railways modernisation plan has been further implemented by the construction of six third class sleeping coaches in Eastern Railway workshops at Kanchrapara. These are prototype stock which will determine future designs.

The coaches are equipped with berths in two tiers. The folding upper berths are upholstered in 2-in. Dunlopillo with rexine covering, a notable improvement over the past practice and a step taken to make third class travel more comfortable and interesting. These berths are to serve as sleeping berths and kept in the closed position locked during day light hours and made available to passengers at night on payment of a small surcharge of Rs. 3/— a night. The berths are of timber.

From the point of view of amenities, these cars are a distinct improvement on the 3—tier Janata Sleeping Cars which were introduced about six years ago. These cars meet some of the passengers' complaints about the Janata Cars and add a few new amenities.

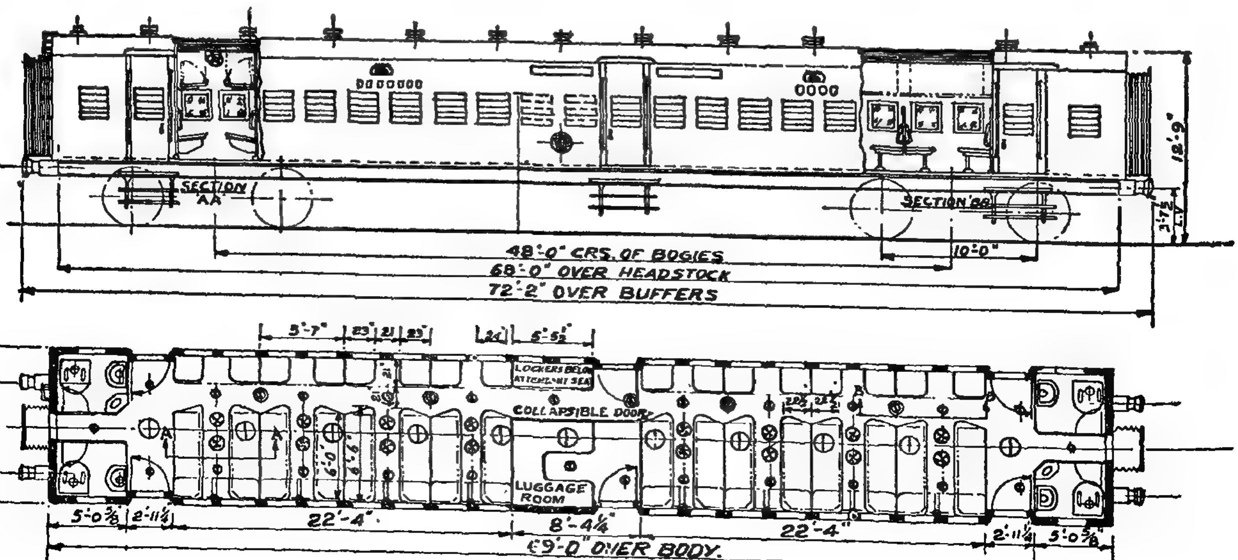
The new service is to operate on the following railways: South Eastern Railway, Northern Railway and Southern Railway, to which these cars have been allotted.

The coaches are of strong timbered construction and 69 ft. over body. Vestibules are included at each end. The bodies with straight sides are 10 ft. 7.3/16 in. over the panels. The body panelling is of 13 G. aluminium alloy sheets. The main roof carlines are of mild steel flat sections of $1\frac{3}{4}'' \times \frac{1}{2}''$ size. The principal dimensions are as follows :—

Length over vestibule end panels	69 ft.
Width over body side panels	10 ft. 8 in.
Height over roof sheets	12 „ 9 „
Gauge	5 „ 6 „
Tare weight	45 Tons. 15 Cwts 2 Qrs.

UNDERFRAME AND BOGIES

The underframe is of riveted mild steel construction to the I. R. S. design with a length of 68 ft. over the headstocks. Draw gear is of the I. R. S. type. The underframe is 9 ft. 3 in. wide over solebars and the body overhang is reduced by fixing body brackets on the sides, ends and corners of the underframe so as to extend the width over the body brackets to 10 ft. 6 in.



Elevation and plan of Prototype Third Class Sleeping Car, showing the Layout of Accommodation.

The bogies are to Indian Railways standard design with a 10 ft. wheel base. They are constructed of riveted rolled steel sections and steel plates. The wheels are rolled steel disc type 3 ft. 7 in. dia. on tread. Inside and outside brake blocks act on all wheels.

Plain bearing axle boxes are fitted in all cases. IRS heavy coil bolster springs are used throughout while the laminated side bearing springs with rubber auxiliary springs carry the individual load on each wheel.

The brake gear comprises the automatic vacuum brake and has two standard 24 in. dia. cylinders; the brake on each bogie being operated by one cylinder.

ACCOMMODATION

Accommodation in each car provides seating for 80 persons and sleeping for 24; the sleeping accommodation is obtained by the provision of hinged upper berths, 16 Nos. placed transversely and 8 Nos. longitudinally. The upper berths are trimmed in brown rexine on foam type rubber cushions.

The seats are arranged transversely affording sufficient knee room for the passengers and inclined to 4 deg. Seats are located at a height of 16" above the floor and are arranged to face each other. In place of the conventional cast iron legs, cantilever type built-up seat brackets have been provided to support the seats made up of timber frame with match boards laid on it. This facilitates easy sweeping and washing of floors. A straight through corridor 1 ft. 9 in. wide connects the vestibules located at the two ends of the coach.

Access is by fixed steps through body side doors, two Nos. of which are provided on each side very near to the ends. In addition to these, two emergency doors located near about the centre, one on each side, have also been provided.

LUGGAGE COMPARTMENT

There is a small luggage compartment of 1½ tons capacity in the centre. The intention is to take charge of the passengers' baggages at the time of entraining and return them on completion of the journey.

This compartment is 8 ft. 4½ in. long by 5 ft. 10½ in. wide and is provided with a collapsible gate to form the corridor. A luggage rack is provided in the compartment. Facing the collapsible gate and in line with the single seat, a seat for the attendant with locker below has been provided. The seat is 4 ft. 4.7/8 in. long × 21" wide. The locker is fitted with a sliding door.

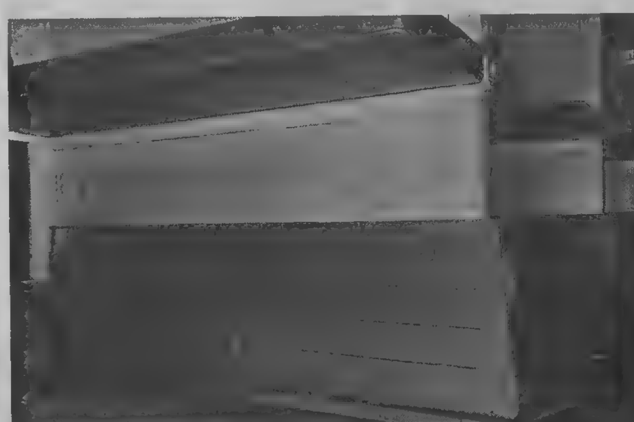
The partitions for the luggage compartment and the lavatories, the transverse partitions and the personal luggage shelves are of block board construction and the body interior is finished with plywood. Flooring consists of oxy-chloride flooring composition laid on G. I. P. pattern floor boards.

VENTILATION

To provide a free outlet for air being exhausted through the roof, the coaches are provided with 11

Interior of the Car showing the Seats along gangway and arrangement of transverse and longitudinal Upper Berths.

(By Courtesy of Public Relations& Publicity Officer, Eastern Railway)



Interior of the Car showing the Seating and Sleeping Arrangements.

(By Courtesy of Public Relations& Publicity Officer, Eastern Railway)

Nos. Oriental type ventilators. The ventilation of lavatories is by Banjo type windows. The upper berth partition is constructed of B. R. C. netting of 3" × 1" rectangular mesh framed in timber for free circulation of air inside the coach.

The transverse upper berths are all of equal size being 6 ft. long and 1 ft. 8½ in. wide. The longitudinal upper berths have been made in two sizes, 5 Nos. being 5 ft. 6 in. × 1 ft. 9½ in. size, three 5 ft. 4 in. × 1 ft. 9½ in. size. Four movable ladders have been placed in each coach for access to these berths.

Amenities for passengers provided in these coaches include 16 Nos. 16" sweep fans of close mesh guard type, 4 Nos. 15 watts blue night lights, a sufficient number of lights including external lights outside the coaches, separate switches for lights, ash trays, safety catches on doors, door windows and body side windows and protection bar fittings on all the window apertures.

LAVATORY ARRANGEMENTS

Four lavatories are arranged at the two ends of each coach. The walls in the lavatories are covered with Eternit granite sheets in light green shade. The

Layout of the Toilet showing Wash Basin, Mirror, etc.
(By Courtesy of Public Relations & Publicity Officer, Eastern Railway)

metallic fittings located inside the lavatories are either of stainless steel or chromium plated. A water supply of 240 gallons is provided by 2 Nos. overhead tanks each of 120 gallons capacity.

The lavatories are equipped with stainless steel latrine flushing pan, wash basin, wall protector, mirror, shelf below mirror, Towel rail, soap tray, Lotah shelf, receptackle for lotah, Coat hooks, bottle opener and hand hold. In addition to the above, two octagonal shaped wash basins with mirrors above are fitted in the Lavatory walls of two lavatories, one at each end, on the compartment side.

Power for the electrical equipment is provided by Stone's 100 amp. Tonum axle driven generator. Accumulators are of the standard Indian Railways of double battery parallel block system; the battery is of the lead acid type of 300 amp. hour capacity. Control of lights is by means of magnetic switches and that of fans by iron—clad switches.

The finish of the exterior is carried out in gulf red enamel with the Railway crest at the bottom panel on both sides. The interior is furnished in a pleasing shade contrast in paints light buff enamel and light brown enamel conforming to the Indian Railways standards practice for third class coaches. The ceiling has been given a white mat finish. The door hand holds are made of stainless steel tube to give a bright appearance. The door locks are also nickel plated for the same reason. All the windows are of "lift—to—open" type and fitted with aluminium alloy louvres.

ACKNOWLEDGEMENTS

For permission to publish this article and to reproduce the drawing and photographs, the author wishes to express his grateful thanks to Messrs. A. K. Mullick and D. J. Batliwala, Chief Mechanical Engineer, Eastern Railway and Deputy Chief Mechanical Engineer, Eastern Railway, Kanchrapara Shops respectively.

WAGON REPAIR WORKSHOP—KOTAH SELECTED

A new broad gauge wagon repair workshop is to be set up at Kotah on the Western Railway at an approximate cost of Rs. 2.10 crores. The Railway Board has also decided that the wagon workshop at Mahalaxmi, near Bombay, should be converted into a carriage repair shop.

The Western Railway is likely to have about 26,500 broad gauge wagons in service at the end of the Second Plan Period. It is necessary to provide for capacity for periodical overhaul of 8,800 wagons per year. As against this, the existing capacity is just over 3,000 per year on the railway.

STEEL MELTING FURNACES FOR CANADA

In keen competition with American and German firms, G. W. B. Furnaces Ltd., have recently received an order from the Canadian Steel Wheel Co., of Montreal, for two 40-ton (40,640-kg) direct-arc steel melting furnaces. The order is worth about $ 500,000 (Rs. 24 Lakhs). The background of this order is that after January 1st next no cast-iron wheels are to be fitted to Canadian or American rolling stock. Wheels will, therefore, be of steel and either cast or forged. Two American-controlled companies operating in this field are going forward with plans to manufacture cast-steel wheels, while the Canadian Steel Wheel Co., is to manufacture wheels of the forged type.

The 3-phase direct-arc melting furnaces will be to the designs of the British company's Italian associates, Leone Tagliaferri & Co., of Milan, although the complete furnace (except the refractories and some ancillary equipment which will be obtained in Canada) will be supplied from the U. K. As stated, the furnaces will be of 40 ton (40,640 kg) capacity, and they will have a 16-ft. (4,877-mm) dia. shell and will be rated at 17,500 kVA through an on-load tapped transformer. Three 18-in (457-mm) dia. graphite electrodes are to be fitted in each furnace. Following the latest steel works practice, the furnaces are of the top-charging type in which the roof is lifted and swung aside to receive the charge from drop-bottom charging baskets. The three graphite electrodes are to be controlled hydraulically by the patented Tagliaferri system which is considered to be superior to the motor-operated method since a finer degree of control and faster electrode operation are obtained, largely owing to the absence of inertia which is inherent with the motor system. This electrode control system is part of a common hydraulic system for tilting the furnace, lifting and swinging aside the roof and raising the door.

The customer's engineers made thorough investigations of the designs of melting furnaces available and were, in fact, able to examine two 40-ton (40,640-kg) furnaces working side by side which were exactly the same except that one had electrically operated electrodes while the other was fitted with a hydraulic control system. In addition to this the Canadian engineers were favourably influenced towards hydraulic control by the recommendations of Premier Steel Mills, Ltd., of Edmonton, Alberta who have recently started operating their second G. W. B.–Leone Tagliaferri 12-ton (12,190-kg) melting furnace. The second Premier Steel Mills melting furnace was one of the units which was inspected by engineers from the Canadian Steel Wheel Co.

* * *

INDIAN IRON ORE SHIPMENTS TO JAPAN

In pursuance of the report submitted to the Government of India last month by the Japanese Technical Survey Mission on a long term programme of Indian iron ore development and its shipment to Japan, two members of the Mission have returned to India as an advance party to discuss with the Government the implementation of the programme. The main party, which includes the presidents of the three leading steel mills of Japan, is expected in the first week of March. The ore programme is to be implemented with assistance from the U. S. President's Regional Development Fund, on an application to be made jointly by Japan and India.

The Mission is reported to have expressed preference for developing the Bailadila Mines in the Bastar District of Madhya Pradesh in the first instance rather than the Kiriburu deposits of the Rourkela region mainly because the Bailadila mines are much nearer to the ore-loading port of Visakhapatnam than the Kiriburu deposits.

The Mission thinks that it would be appropriate to set the target of iron ore shipment from Vizag at two million tons per annum in the first stage, and another two million tons at the second stage, making a total of four million tons per annum. The Mission "agrees in principle as to the Indian Government's proposed expansion scheme" for the first stage, subject to certain modifications it has suggested in respect of the details of the scheme.

Regarding the development of the Visakhapatnam port for the purpose of shipping the newly mined iron ore to Japan, the Mission, has recommended to the Government of India that early steps be taken to increase the width and depth of the entrance channel so that large vessels can be admitted.

The Mission, however, disfavours the development of Paradip as a major port. But in view of the existence of "strict limitations" on the expansion of navigation facilities in the Calcutta port, the Mission has favoured the construction of a subsidiary port at Geonkhali to handle exports of coal and oil besides iron ore.

The Development of High-Speed MERCEDES-BENZ Diesel Engines for Diesel train traction

By Dr. Ekhart Schmidt,
Stuttgart-Unterturkheim

THE development of high-speed diesel engines, in particular, of those with a high output, for powering diesel trains was greatly encouraged by the Deutsche Reichsbahn (German State Railways) which planned, designed and operated diesel railcars over 25 years ago. The Deutsche Bundesbahn (German Federal Railways), the successor in the Federal Republic of Germany to the Deutsche Reichsbahn, has resumed this tradition after the war and is pursuing it with great vigour, in particular, as far as main line traffic is concerned. New diesel railcars—express railcars and diesel locomotives—which have been developed (1, 2, 3) are playing an increasingly important part in long-distance traffic in the Federal

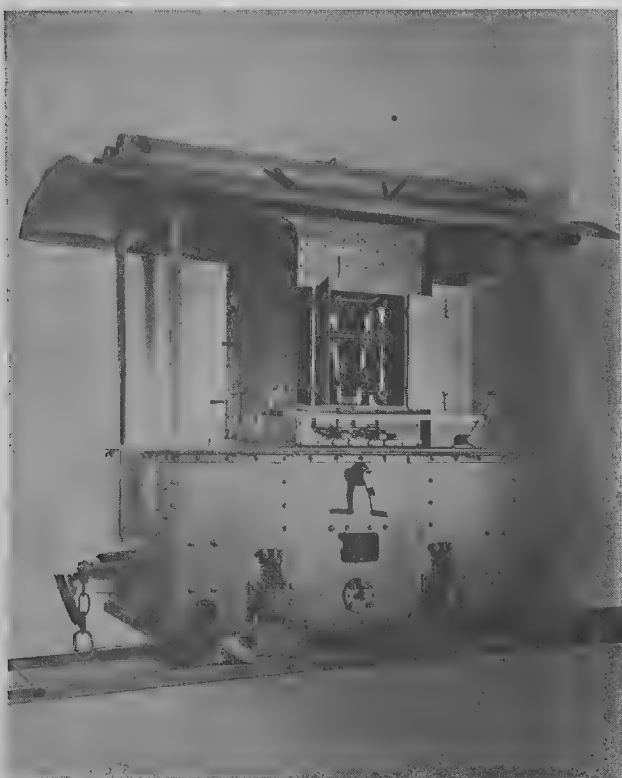


Fig. 1. Engine-powered locomotive of the Daimler-Motoren-Gesellschaft, made in 1887, Ne = 5.5 PS, n = 620 r.p.m.

Fig. 2. MERCEDES-BENZ 12 cylinder Diesel engine MB 805, built in 1932, Ne = 300 PS, n = 1,500 r.p.m.

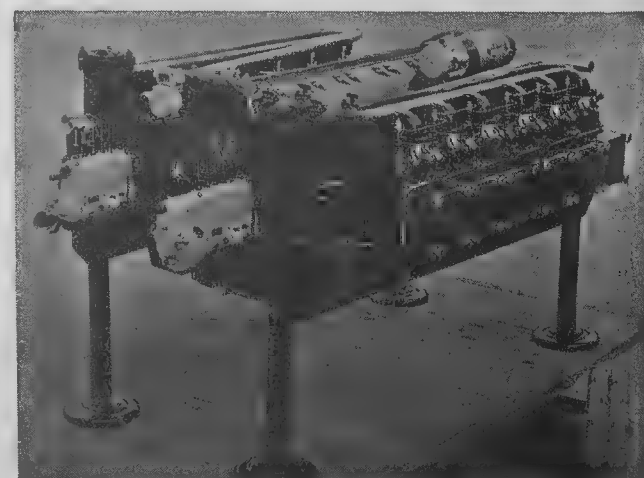


Fig. 3. MERCEDES-BENZ 12 cylinder Diesel engine MB 807, built in 1936, Ne = 275 PS, n = 1,500 r.p.m.

1) Lampe, Curt und Pflug, Erhard:
Die 1000-PS-Diesellokomotive der Deutschen Bundesbahn fur leichten Strecken—und schweren Rangierdienst. – Glas. Ann. (1952) Nr. 4 S. 72/86

2) Lampe, Curt und Goessl, Nikolaus:
Die 2000-PS-Diesellokomotive der Deutschen Bundesbahn. ETR 2 (1953), Nr. 6/7, S. 275/289

3) Lampe, Curt:
Grundzuge der Diesellokomotive-entwicklung bei der Deutschen Bundesbahn. MTZ 14 (1953), Nr. 8, S. 223/225

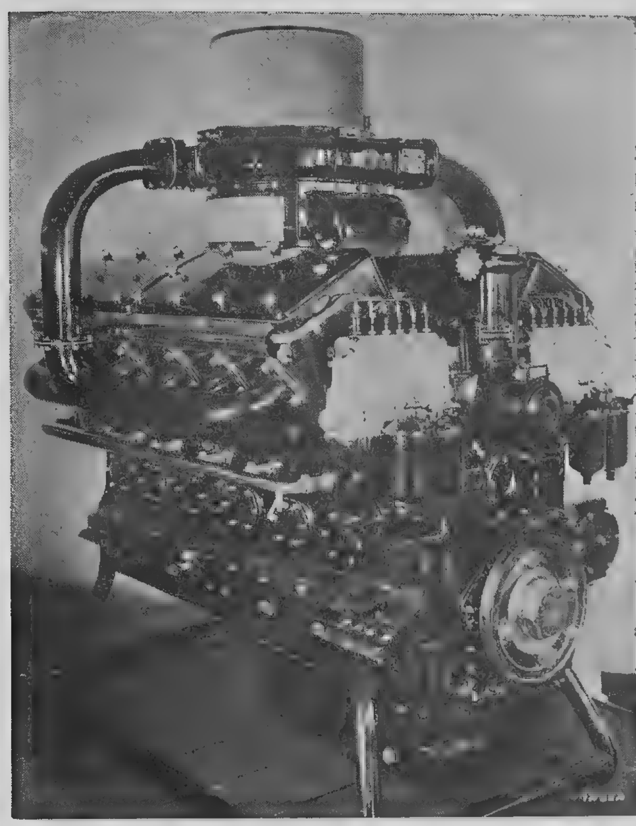


Fig. 4. MERCEDES-BENZ 12 cylinder Diesel engine MB. 816, with BBC exhaust gas turbo-charger, built in 1938, Ne = 650 PS, n = 1,400 r. p. m.

Fig. 5. Express railcar of the Belgian State Railways, equipped with 2 MERCEDES-BENZ Diesel engines MB 806 each of which has an output of 450 PS, maximum speed 93 to 100 m.p.h.

Republic and are frequently installed in trains which run to the capitals of neighbouring countries.

Fig. 6. Bogie of a Diesel railcar with diesel-electric transmission with MERCEDES-BENZ Diesel engine MB 806, built in 1936, Ne = 450 PS, n = 1,400 r.p.m.

Side by side with this development, the use of high-speed diesel engines for shunting operations is constantly gaining ground not only on account of the great economy of operation of the diesel engine which is undisputed in this special field but also because of the advantages of the high-speed engine as such.

Ever more powerful units, larger by far than those which are increasingly being used for diesel rail buses, are being built into railcars which operate on branch lines. These have a higher haulage capacity and can be operated with trailcars, as well as with goods wagons, etc. as the case may be.

The reasons for the use of high-speed engines must be sought in the fact that they are extremely suitable

Fig. 7. MERCEDES-BENZ 12 cylinder diesel engine MB 820 Bb with BBC exhaust gas turbo-charger, Ne = 1,100 PS, n = 1,500 r.p.m.

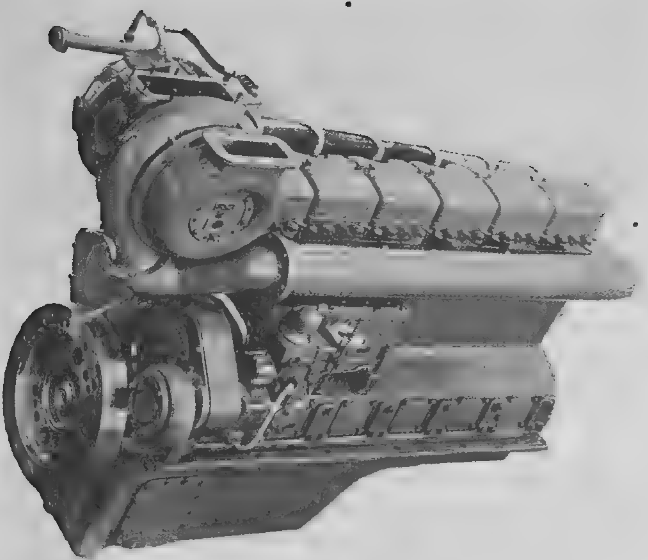


Fig. 8. MERCEDES-BENZ 6 cylinder diesel engine MB 836 Bb with BBC exhaust gas turbo-charger. Ne = 500 PS, n = 1,500 r.p.m.

for installation in rail-bound vehicles. Since they have smaller dimensions and a lower structural weight, possibilities are opened up which are non-existent with the much heavier low-speed engines. Thus the installation of engines in the bogie, e. g. of Diesel railcars, is limited to sizes and weights which preclude the use of engines with low revolution speed. For this reason the development of express railcars for long-distance traffic which was sponsored by the German State Railways and the German Federal Railways could not have been effected if light, high-speed Diesel engines had not been available, and my later remarks will show that it has recently proved possible to install such engine units with an output of 1100 PS and more in the bogie. There are prospects of increasing these output figures still further. Because they save space and weight, the high-speed engines offer a great many advantages for installation in Diesel locomotives. Thus the number of axles is determined by the permissible load per axle and the use of light and small engines makes it possible to limit the number of axles, which in turn results in the use of cheaper locomotives designs, indeed, in many cases it makes it at all possible to operate at certain output ranges although the bearing capacity of the superstructure is limited. Obviously, these remarks are only valid within the limits set by the adhesion weight of the locomotives required for the trailer load.

The advantages of using smaller and lighter, that is to say, high-speed engines not only lie in the field of diesel vehicle design but also to a very large extent in the operational and economical range.

The fact that those parts in the installed engine which require servicing can be quickly dismounted, whilst their weight remains slight, and that the engines can be easily exchanged for the routine overhauls, contributes considerably to economical operation inasmuch as the time during which the vehicles are out of operation so that work can be done at the engine plant can be considerably cut down or eliminated altogether. Minor maintenance jobs only require little time whilst more important jobs are not carried out in the vehicle since the light engine can be dismounted very quickly indeed and replaced by an exchange unit.

Like other German firms, *Daimler-Benz* has played an important part in the development of high-speed engines for rail-bound vehicles. At the birthplace of the first high-speed combustion engine of the Daimler-Motorengesellschaft which has been designed by Gottlieb Daimler in 1883, the first rail-bound vehicles of the world to be equipped with combustion engines, among them the first engine-driven locomotive (Fig. 1) were built as early as 1887.

Before the last war, high-speed engines ranging from 35 to 650 PS, make *Daimler-Benz*, were available for Diesel train traction. Below, we shall only deal with engines with a higher output—from 275 to 650

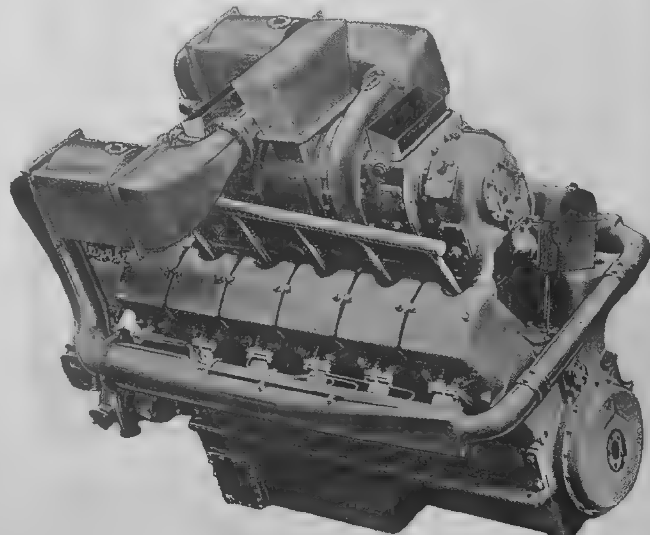


Fig. 9. MERCEDES-BENZ 12 cylinder diesel engine MB 820 Db with high-supercharging by a BBC exhaust gas turbo-charger and intercooling, Ne = 1,350 PS, n = 1,500 r.p.m.

PS at 1,500 r. p. m.—which have undergone further development culminating in the new types which, as already mentioned, have outputs of 1100 PS at the same engine speed.

In the output range between 275 and 650 PS, three engine types were increasingly being used by the Deutsche Reichsbahn before the war:

1. The engine MB 805, 12 cylinders, in V-arrangement, 138 mm. (5 7/16 in.) bore, 170 mm. (6 11/16 in.) stroke, $V_H = 30.5$ 1, not supercharged, with an output of $N_e = 300$ PS at n = 1,500 r. p. m. (Fig. 2).
2. Engine MB 807, 12-cylinder, opposed cylinder arrangement, with the same dimensions as engine MB 805, not supercharged, with an output of $N_e = 275$ PS at n = 1,500 r. p. m. (Fig. 3).
3. Engine MB 806, 12 cylinders in V-arrangement, 165 mm. (6½ in.) bore, 195 mm. (7 11/16 in.) stroke, $V_H = 50.0$ 1, not supercharged with an output of $N_e = 450$ PS at n = 1,400 r. p. m.

   supercharged by a BBC exhaust gas turbo-charger as MB 816 with an output of $N_e = 650$ PS at n = 1,400 r. p. m. (Fig. 4).

The engine output was transmitted mechanically, electrically, hydraulically or hydraulic-mechanically as the case may be, whereby equally good results were achieved with the diesel-electric and diesel-hydraulic

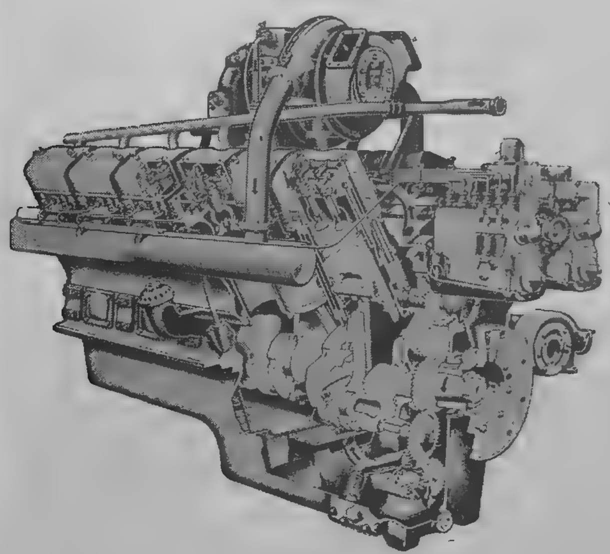


Fig. 10. MERCEDES-BENZ Diesel engine MB 820 Bb – sectional view.

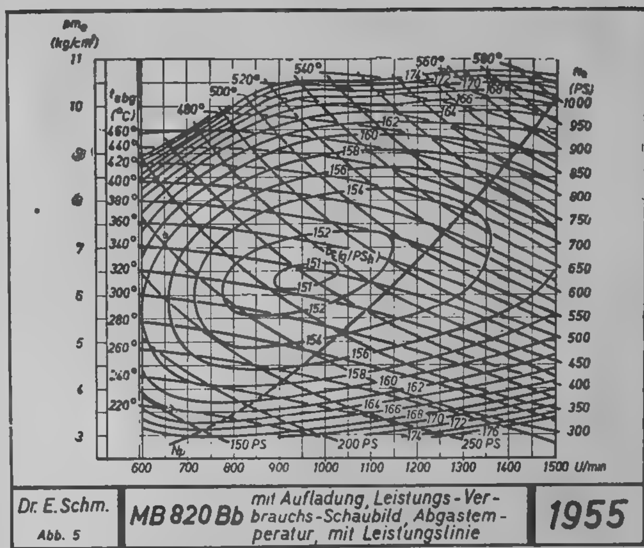


Fig. 11. MB 820 Bb with BBC exhaust gas turbo-charger, Ne = 1,000 PS, n = 1,500 r.p.m., output consumption diagram, exhaust gas temperature, with output curve for diesel-hydraulic drive.

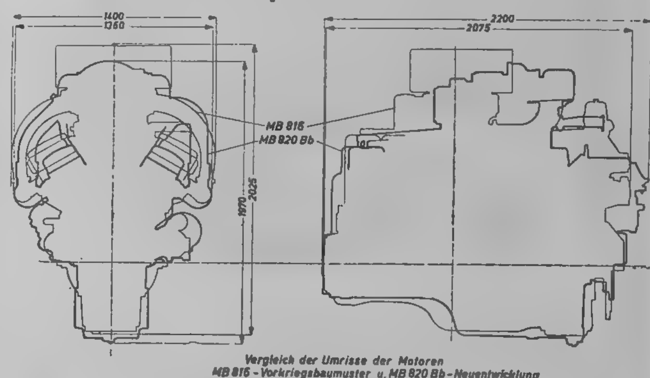


Fig. 12. Comparison of the basic designs of engines MB 816 (pre-war type) and MB 820 Bb (new design).

types of power transmission. The hydraulic or hydraulic-mechanical system of transmission determined the entire post-war development of diesel train traction by the Deutsche Bundesbahn.

The following figures show examples of installation of the engine types aforementioned:

Fig. 5: Express railcars of the Belgium State Railways equipped with two *Mercedes-Benz* diesel engines of type MB 806, each of which renders an output of 450 PS, maximum speed 93 to 100 m. p. h. Fig. 6: Engine MB 806, installed in the bogie of an express railcar with diesel-electric power transmission.

The demands which must be kept in mind when designing high-speed diesel engines for rail-bound vehicles are resistance to very hard operating conditions, in particular in view of the many extreme load and engine speed changes involved, on the one hand, and high resistance to wear and long service life of all those engine parts which, if they have to be overhauled, make it necessary to dismount the engine, namely the bearings, and the cylinder bushings and pistons, on the other hand. Such demands are not easily met and they required considerable and very detailed development work. Nevertheless, it was

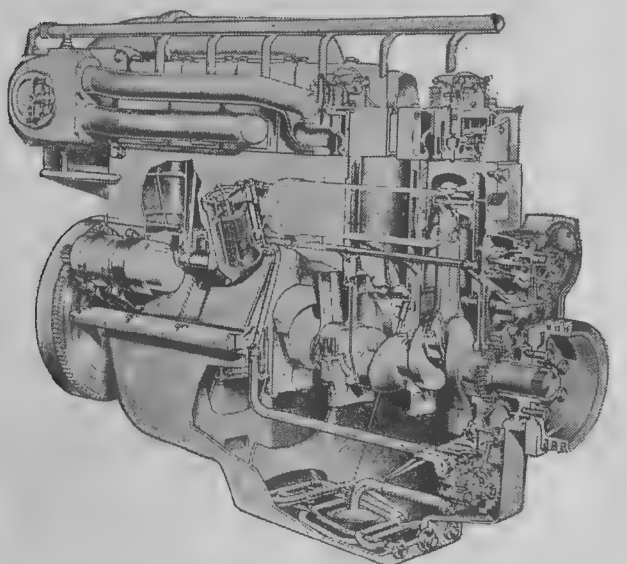


Fig. 13. MERCEDES-BENZ diesel engine MB 846 Ab - sectional view.

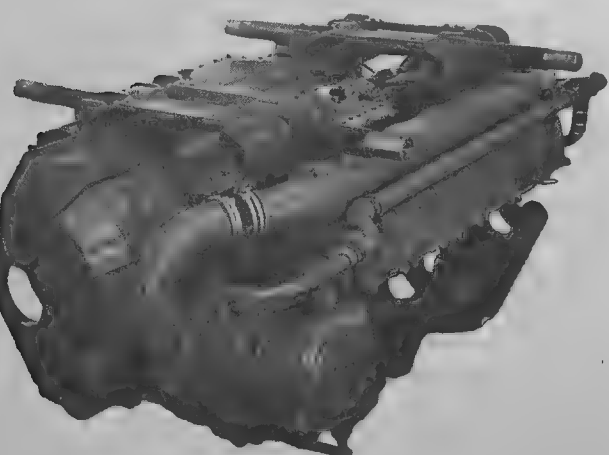


Fig. 14. MERCEDES-BENZ 6 cylinder underfloor Diesel engine MB 846 Bb, Ne = 300 PS, n = 1,500 r. p. m.

Fig. 15. The carriage body is lowered on the bogies of a Diesel railcar equipped with a MERCEDES-BENZ diesel engine MB 820 Bb, Ne = 1,000 PS, n = 1,500 r. p. m.

possible already before the war to reach service figures of 4,000 operational hours with engine MB 806 under very hard operational conditions, e. g. in express traffic in the Ruhr area, before dismounting the engine for an overhaul.

After the war considerably higher performance standards were set from the very beginning for the express railcars and Diesel locomotives which had been newly developed by the Deutsche Bundesbahn. For the railcars VT 08[3]) and the Diesel locomotives V 80[1]) this was at first 800 PS per engine, a figure which was soon raised to 1,000 PS whilst two engines with 1,000 PS were at first installed in the Diesel locomotive V 200[2]) the output of which has recently been raised to 1,100 PS. These demands for higher performance per unit would have led to new engine developments after the war even if it would have been possible to resume manufacture of the pre-war engines. The work of development which was then carried out naturally utilised the fund of experience accumulated both before and during the war with the construction and operation of light, high-speed Diesel engines. *Daimler-Benz* brought out two new engine types with the designation MB 820 (Fig. 7) and MB 836 (Fig. 8), one of which is a 12-cylinder engine whilst the other has 6 cylinders, both of them, however, have the same stroke and

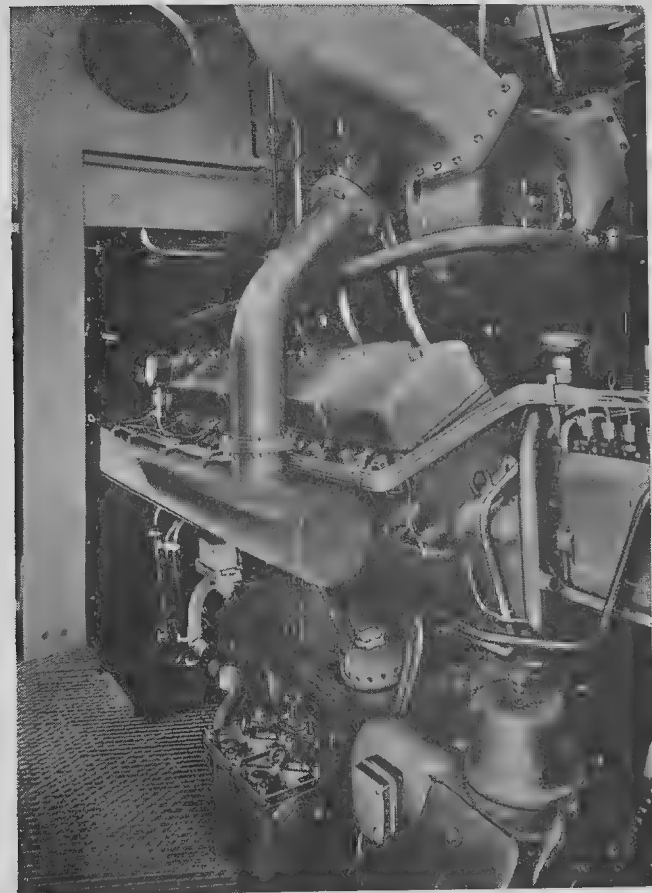


Fig. 16. Engine compartment of the diesel locomotive V 200 of the Deutsche Bundesbahn equipped with 2 MERCEDES-BENZ diesel engines MB 820 Bb, Ne = 1,100 PS, n = 1,500 r. p. m.

bore and many of their components, such as piston rods, cylinder bushings, pistons, cylinder heads, all control parts, injection pumps and nozzles, to name but a few, are also the same, in other words, nearly all parts which have to be overhauled and, possibly, exchanged. This provides considerable advantages with regard to stocks of spare parts, reconditioning, training of personnel, etc. if both types are operated by the same railway company, as they are by the Deutsche Bundesbahn. Both types have been built in a non-supercharged and in a supercharged design, in which case BBC exhaust gas turbo-chargers were used, to the following specifications:

	MB 820	MB 836
Stroke	205 mm.	205 mm. (8 5/64 in.)
Bore	175 mm.	175 mm. (6 57/64 in.)
No. of cylinders	12	6
Cylinder arrangement	V	in line
Engine speed n	r. p. m. 1,500	1,500
Type designation of the engine, not supercharged	MB 820 B	MB 836 B
Output when n = 1 = 1,500 r. p. m.	PS 700	350
Type designation of supercharged engine	MB 820 Bb	MB 836 Bb
Output when n = 1,500 r. p. m.	PS 1100	500

Both types are also built with intercooling—type designation MB 820 Db and MB 836 Db respectively (Fig. 9) —a design which is mainly used for ship propulsion units, but also for railways operating under tropical conditions and, under certain circumstances, in order to raise the output. The output available in each case depends on the prevailing atmospheric conditions (temperature, humidity) and on the circumstances governing installation (e. g. possible size of cooling unit).

We do not propose to go into the technical design of engines MB 820 and MB 836 and of the pre-war types in detail. We refer the reader to earlier publications (4., 5.). We shall only select a few essential points using the sectional view of engine MB 820 Bb (Fig. 10) to make ourselves clear, and compare them with the earlier types.

The crankcase of the new engine type is made of heat-treated silumin like the earlier one, but that of the newer design is drawn up to the upper edge of the cylinder and thus very rigid, special cylinder blocks of cast iron—in each case jointly for three cylinders—were separately placed on the crankcase of the earlier types. Cylinder liners of special alloys are

4) Buschmann, Heinrich: Triebwagenmotoren. MTZ 1 (1940), Nr. 5, S. 139/152.
MTZ 1 (1940), Nr. 6, S. 209/212.

5) Schilling, Otto: Der neue 800-PS-Daimler-Benz-Triebwagen-Dieselmotor mit mechanisch angetriebenem Lader oder Auspuff-aufladung. MTZ 11 (1950), Nr. 4, S. 93/96.

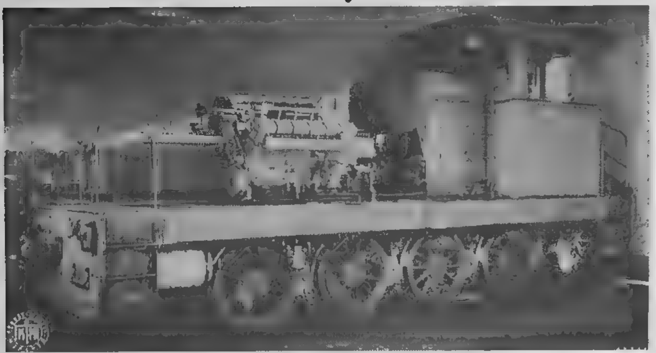


Fig. 17. A MERCEDES-BENZ diesel engine MB 820 B without supercharging, Ne = 700, n = 1,500 r. p. m. being mounted in a shunting locomotive of Messrs. Krauss-Maffei A. G., Munich.

mounted in these cylinder blocks and, in the new types, in the crankcase, these liners are specially adapted to the light-metal pistons and piston rings used in all types. In the new types, the upper piston ring is chrome-plated in order to further reduce wear. The crankshaft has heat-treated journals, case hardened or induction hardened, and runs on steel-backed lead bronze bearings. The design of the bearings is in principle the same as in the earlier types, except that lead bronze has also been further improved and a surface layer of lead with a thickness of 0.02 to 0.03 mm. has been laid on the lead bronze—in the new designs—which advantageously effects the running properties.

The piston rods in the 12-cylinder engines MB 820 and MB 806 have a different design. Whereas the main connecting rod of the pre-war engine MB 806 was of the forked type with an auxiliary rod oscillating on the bearing shell on the outer side, in engine MB 820 the piston rods of two opposite cylinders lie next to each other on the same crankpin, a design which permits the use of the same connecting rods for all 12 cylinders.

Special care has been expended on the new types to ensure that the time required for overhauling and checking those parts of a built-in engine which have to be serviced is kept as low as possible, for this reason single cylinder heads have been provided as against the joint cylinder heads for 3 cylinders which were the rule in the pre-war types. This is the only way to cut down on the time required for the maintenance of a built-in engine, since no lifting appliances of any kind are required to remove the single cylinder heads made of special cast iron. The heads are directly accessible and can be lifted up, after the nuts of the cylinder head bolts have been loosened, without dismounting the intake and exhaust lines. This is further facilitated by the fact that the valves are actuated by push rods as they were in the pre-war engines too. In the cylinder head, there are 2 intake and exhaust valves each around the pre-chamber which lies in the center.

Both engine MB 816, which is a pre-war type, and the new engine types are charged by BBC exhaust gas turbo-chargers.

In engine MB 816, one supercharging unit with vertical axis was over the V, it was not cooled. In

Fig. 18. Bogie of a diesel railcar with MERCEDES-BENZ diesel engine MB 836 Bb, Ne = 500 PS, n = 1,500 r. p. m.

Fig. 19. Shunting locomotive of Messrs. Krauss-Maffei A.G., Munich, equipped with a MERCEDES-BENZ diesel engine MB 836 Bb, Ne = 500 PS, n = 1,500 r. p. m.

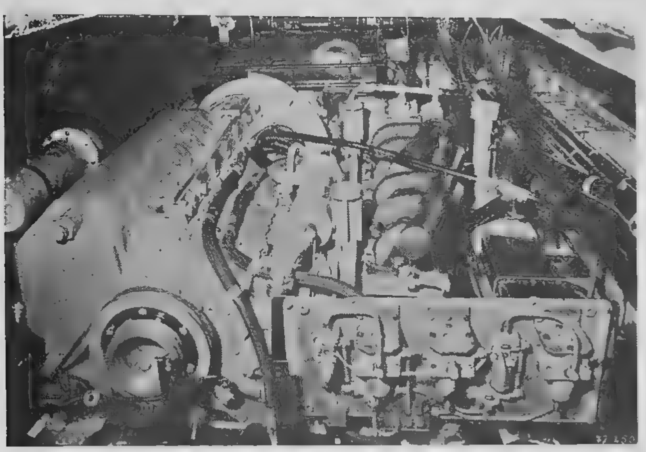


Fig. 20. Installation of MERCEDES-BENZ underfloor diesel engine MB 846 Bb, Ne=300 PS, n=1,500 r. p. m. in a railcar " DGT 600 ".

engines MB 820 and MB 836 water-cooled supercharging units with horizontal axis are used. In engine MB 820 Bb the unit is located over the V, in engine MB 836 Bb at the end of the line of cylinders. The engine MB 820 Db which has intercooling and high supercharging has 2 supercharging units one behind the other in the V, whereas the intercooler is so arranged over the lines of cylinders that it does not impede the dismounting of the cylinder heads.

Special care has been expended on the design of the parts of the cumbustion chamber as well as of the injection system. All engines work according to the four-stroke principle. The combustion chamber greatly differs from the pre-war types, although the pre-chamber system has been retained and has thus undergone considerable further development.

Fig. 11 shows the output consumption diagram of engine MB 820 Bb in its previous design for $N_e = 1{,}000$ PS at $n = 1{,}500$ r. p. m. without intercooling and with normal supercharging. It will be seen that the minimum consumption approximates to 150 g/PSh and lies under 160 g/PSH for a wide range. The output curve according to which the engine is operated with the hydraulic drive of the vehicles of the Deutsche Bundesbahn has also been traced in the diagram.

In the meantime, the output of engine MB 820 Bb without intercooling has been raised to 1,000 PS at 1,500 r. p. m. thanks to improvements in the exhaust gas turbo-chargers and injection system. At the same time, it has proved possible to reduce both the consumption at 1,100 PS and the exhaust gas temperature below the level which was previously reached with the 1,000 PS engines.

It is interesting to compare the two engines MB 806/816 with the engines MB 820 B/MB 820 Bb in respect of specific output, space requirements and weight, since this clearly illustrates the considerable improvements which have resulted from further development work on the high-speed Diesel engine. Fig. 12 compares the basic designs of the two supercharged engines MB 816 and MB 820 Bb.

		MB 806	MB 820 B
Length	mm	2125 (83 $\frac{21}{32}$ in.)	2200 (86$\frac{5}{8}$ in.)
Height	mm	1685 (66 $\frac{5}{16}$ in.)	1540 (60$\frac{5}{8}$ in.)
Width	mm	1410 (55 $\frac{1}{2}$ in.)	1300 (51$\frac{1}{4}$ in.)
V_H	l	50.0	59.2
Weight	kg	2500 (5,500 lbs.)	2450 (5,390 lbs.)
Output	PS	450	700
n	r.p.m.	1400	1500
p_e	kg/cm²	5.8 (82 psi)	7.1 (100 psi)
Power-weight ratio	kg/PS	5–55	3.5

		MB 816	MB 820 Bb
Length	mm	2075 (81$\frac{11}{16}$ in.)	2200 (86$\frac{5}{8}$ in.)
Height	mm	2025 (78$\frac{3}{4}$ in.)	1970 (77$\frac{8}{16}$ in.)
Width	mm	1400 (55$\frac{1}{8}$ in.)	1360 (53$\frac{17}{32}$ in.)
V_H	1	50.0	59.2
Weight	kg.	2820 (6,200 lbs.)	2800 (6,160 lbs.)
Output	PS	650	1100
n	r.p.m.	1400	1500
p_e	kg/cm	8.35 (119 psi)	11.2 (171 psi)
Power-weight ratio	kg/PS	4.35	2.55

From Fig. 12 and the table above it can be seen, that whilst the pre-war type and the newly-developed designs have approximately the same space requirements, the output of the non-supercharged engine has been raised by 55% whilst that of the supercharged one has undergone an increase of 70%, besides increasing the engine speed from 1,400 to 1,500 r. p. m. the mean effective pressure was raised by a third. It has proved possible to reduce the

power-weight ratio quite considerably: from 5.555 to 3.5 kg/PS in the non-supercharged and from 4.35 to 2.55 kg/PS in the supercharged engine.

The two above-mentioned types MB 820 and MB 836 were supplemented by another type, namely engine MB 846, a 6-cylinder in-line engine with a total piston displacement of 201, a bore of 150 mm. and a stroke of 190 mm. This engine is manufactured both as a vertical engine—Fig. 13—and as a horizontal engine—Fig. 14. It renders an output of 225 PS at 1,500 r. p. m. when supercharged, and further efforts are being made to improve both out put and engine speed.

The engine has the same basic design as type MB 836. The crankcase—in this case of cast iron—is also drawn up to the edge of the cylinder. This engine too, has inserted wet cylinder bushings of special cast iron, light metal pistons with top chrome-plated piston ring, and a crankshaft with induction-hardened crankpins running on lead bronze bearings. The single-cylinder heads have only one exhaust and intake valve each, which means that the pre-chamber has been slightly shifted away from the center of the cylinder. The exhaust gas turbo-charger lies at the end of the cylinder line as in the MB 836.

The above-mentioned three new types of engines MB 820, MB 836 and MB 846 have been extensively used in the most various kinds of railway drive units. Engine MB 820 Bb has been mainly installed in the express railcar VT 08 and in the Diesel locomotives V 80 and V 200 of the Deutsche Bundesbahn. Fig. 15 shows a carriage body being lowered onto the bogies of railcar VT 08, Fig. 16 shows the engine compartment of the Diesel locomotive V 200 with the same engine. The non-supercharged engine MB 820 B is used for shunting locomotives. Fig. 17 shows a locomotive which is built by the firm of *Krauss-Maffei A. G.*, Munich, in process of being assembled. The low design of the non-supercharged engine results in excellent visibility in the completed locomotive. Moreover, when certain types of power transmission are used, e. g. with a mechanical type of power transmission, the characteristics of the non-supercharged engine are unusually advantageous.

Engine MB 836 is used for railcars with an output up to 500 PS both by the Bundesbahn and by other railway companies as well as being installed in shunting locomotives to an increasing extent. As

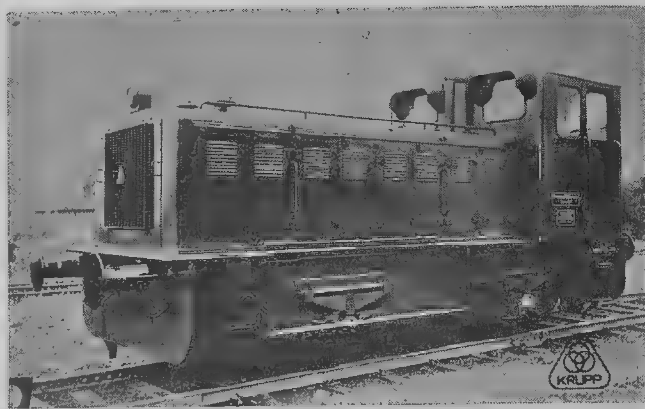


Fig. 21. Shunting locomotive of Messrs. Fried. Krupp, Essen, equipped with a MERCEDES-BENZ diesel engine MB 846 A, Ne = 225 PS, n = 1,500 r.p.m.

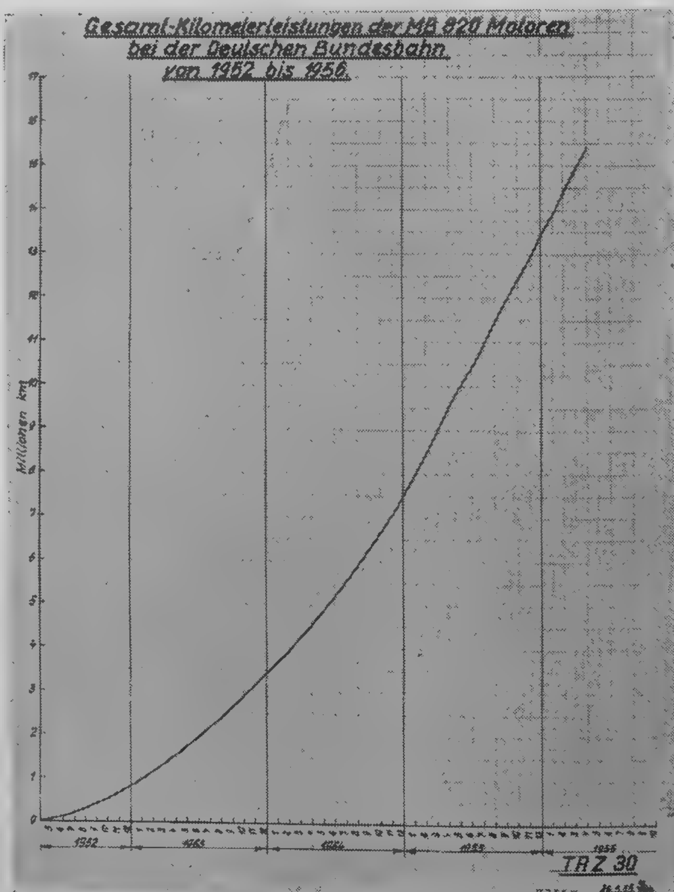


Fig. 22. Total kilometer performances of the MB. 820 engines in the service of the Deutsche Bundesbahn from 1952 to 1956.

examples of the type of installation involved, we should like to call the reader's attention to the bogie

GOLDEN RULES OF CONDUCT FOR RAILWAYMEN

1. Maintain proper relations with officers and others in the Department in which you work.

2. Use good human relations in your contact with subordinates. Do not make them feel their position.

3. Maintain good public relations with callers and passengers.

4. Be resourceful and find ways and means of doing a job well.

5. Discard the idea of 'Give me some more men to do the job'.

6. Learn the art of getting along with people.

7. Remember the most important thing is to get a job done—not just to do it anyway and somehow but to do it efficiently, safely, economically and expeditiously.

8. Develop the attitude of 'Give me plenty of rock and plenty of wood and just get out of my way'. This typifies loyalty and enthusiasm for work and responsibility.

★ ★ ★

1. Get down to the man on the JOB.

2. Move on the line as often as you can as MEMBERS OF THE PUBLIC and not only as officials.

3. Remember pre-arranged and announced expeditions cannot have the same informative value as surprise inspections

4. Every railwayman has to be convinced that the work that he does is to his own advantage. He should not think and measure his effort merely in terms of wages which is only a motive force.

5. Every railwayman does a specialised job which has no meaning or usefulness by ITSELF unless it is cohered with each other. There is no meaning or value to the work of a permanent way gang unless there are trains to run over the track.

of a branch line railcar—Fig. 18—and to a shunting locomotive built by the *Krauss-Maffei A. G.*, Munich,—Fig. 19. Thanks to the small narrow engine, this locomotive boasts first-rate visibility.

The horizontal design of engine MB 846 is increasingly gaining in importance as an underfloor engine for railcars. Fig. 20 shows the installation of one of two engines MB 846 Bb of 300 PS each in a railcar of the "DGT 600" design. In its vertical design as MB 846 Ab, the engine is frequently used for shunting locomotive operation. Fig. 21 shows a locomotive which has been built by Messrs. *Fried. Krupp*, Essen.

These examples of the fields of application for the above-mentioned engine types of the *Daimler-Benz Aktiengesellschaft* for diesel rail operation could easily be multiplied. It will be noted that the high-speed engine for all types of rail operation—shunting service, branch line operation, main line operation, express trains service—has acquired supreme importance. We have mentioned above that the further improvement of these engines has required protracted and extremely detailed development work. The results of this work can be seen in the fact that the field of application for these engines has been considerably extended.

Earlier fears that the high-speed engine would have a higher rate of wear and tear that the low-speed ones have been proved wrong by the experiences gained with the new engine types, at least. The degree of wear of the susceptible parts is kept within such narrow limits as far as the above-mentioned engine types are concerned that, after 5,000 operational hours, for instance, no part subject to wear and tear had to be overhauled because the operational tolerance limits of play and wear had been reached. In partly very hard shunting operation, engines MB 836, for instance, were in operation for over 10,000 hours without requiring an overhaul, and 6,000 operational hours have been exceeded by engine MB 846 which has not been in operation for such a long period yet.

As far as engines MB 820 are concerned, the Deutsche Bundesbahn has covered an operational distance of over 9 million miles — Fig. 22 — with very low operational failure figures due to engine defects. In this connection, it should be pointed out that some engines have covered distances of over 18,000 miles, the average figures for the past year show that 88% of the engines were in operation every month, a sign of their high efficiency. We shall report on the experiences and results gained in operation in more detail in another article.

SUMMARY

Continuing its tradition of building high-speed engines, the *Daimler-Benz Aktiengesellschaft* had developed high-speed, high-performance diesel engines with outputs up to 650 PS for rail-bound vehicles, with which impressive mileage figures have been achieved, long before the war already. After the war, three new types of high-speed high-performance diesel engines were developed which have found a wide field of application in all kinds of rail operation—shunting service, branch line operation, main line operation, express train service—and which have everywhere demonstrated their reliability whilst the wear and tear figures recorded are very low indeed. The author points out the advantages of using high-speed light engines for rail operation and describes the design of the new types of engines which meet the requirements of rail operation particularly well. A comparison with pre-war engines illustrates the progress which has been made with the construction of high-speed high-performance diesel engines. Selected examples show the varied possibilities of operation in the service of railway companies.

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900 RAILWAY STATIONS TO BE ELECTRIFIED

Over 900 railway stations are to be electrified during the Second Five-Year Plan period, according to a report. The report says that from April 1, 1956, until the end of September this year electricity has been extended to 194 stations and 740 more stations are to be electrified by March 31, 1956.

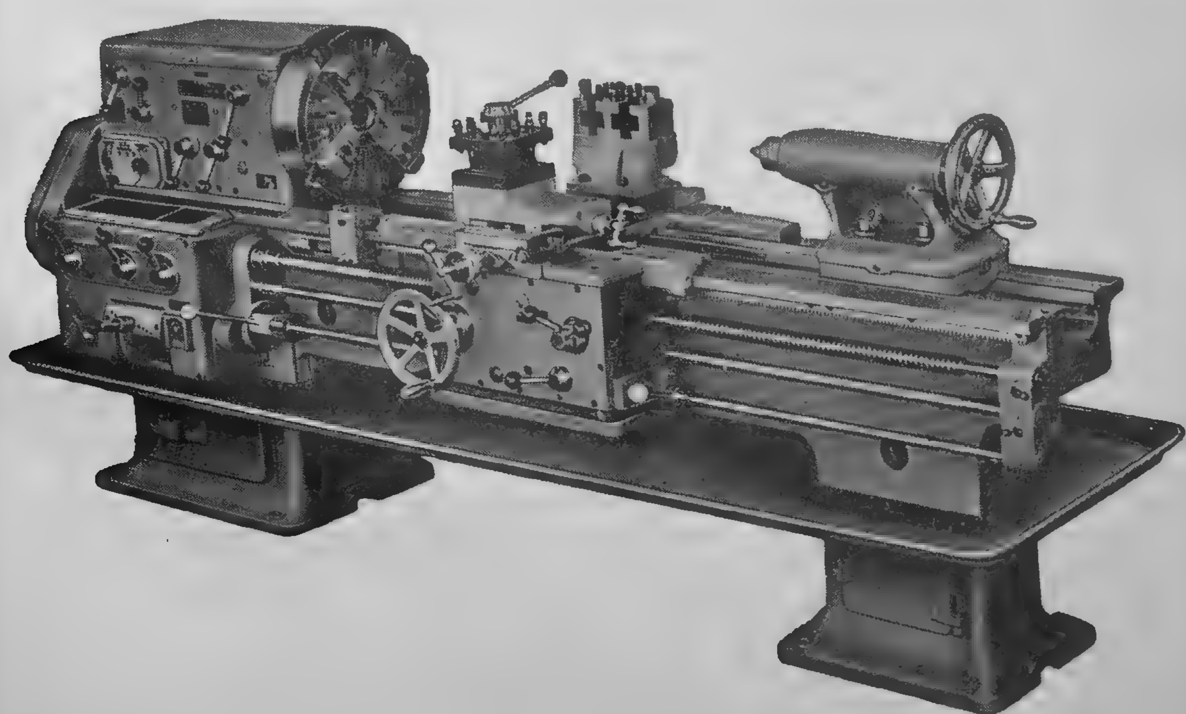
The Railway-wise break-up of stations to be electrified during the Second Five-Year period is as follows: Western Railway 82, Central Railway 66, Eastern Railway 146, North Eastern Railway 140, Northern Railway 147, Southern Railway 245, and South Eastern Railway 108.

The Model DLNE High Speed Lathe

FOR many years this has been the standard machine on the WEISSER HEILBRONN production programme and has become especially popular in foreign countries. It may be designated as the *Prototype of the traditional Engine Lathe.* This machine is not only used in production plants but is also standard equipment in the repair shops of mines, textile and paper factories and chemical plants, as well as in large scale garages and omnibus repair shops and railroad shops both at home and abroad.

This machine, too, is characterized by typical WEISSER HEILBRONN features :

1. All gear wheels and sliding gear shafts are of hardened chrome nickel steel and have precision ground tooth flanks.
2. In place of six spline shafts they are exclusively equipped with triangular K-profile shafts (patented by Krause, Vienna). These shafts have proven their merits on WEISSER HEILBRONN machines for over 12 years.
3. Surface hardened main spindle with lapped bearing surfaces. A pressure lubrication system for main spindle. A pump presses 8 litres of oil through the bearing per minute, so that absolutely correct lubrication is warranted.
4. Patented apron construction with a release accuracy of 0.01 mm by which recoiling of the slide and tool breaking are eliminated.
5. Honed tailstock bore (superfinish).
6. Safety devices on the control shaft give full protection against accidents and make unintentional starting impossible.
7. Transverse feed slide has T-slots in rear for



Engine Lathe Model DLNE.

HOW TO RESERVE ACCOMMODATION

Unless you reserve your berth (I Class) or Seats (II and 3rd Class long distance) in advance, you may not be sure of getting accommodation on the train you wish to travel by.

Application should be made to the Station Master of your starting station at least 3 days in advance specifying the date and train by which you intend travelling and the tickets must be bought in advance. The reservation fee leviable is 8 Annas per seat or berth.

Reservation by I and II Class from intermediate stations by Express trains can also be made similarly, but reservation ticket can be issued only after getting an advice from the Reservation Centre that the reservation has been made.

Tickets will be issued only if accommodation is available.

If the reserved seats or berths are not occupied at least 5 minutes before the booked departure of the train the reservation will be cancelled and the seat or berth given away to another.

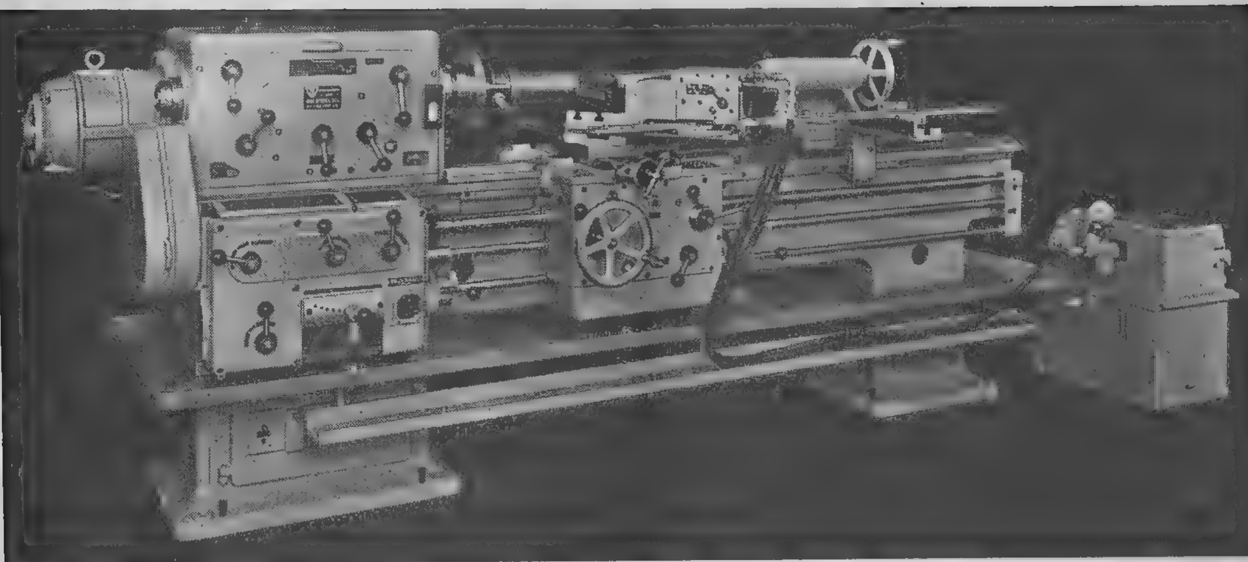
Reservation fee is not refundable.

III Class seats are also reservable on Express and certain other important trains for long distance passengers from the train-starting stations on payment of a reservation fee of 4 Annas per seat.

Do not occupy a berth or seat reserved for another, as you are liable to be displaced at the last moment.

If you find another person occupying the berth or seat reserved for you and if he will not vacate it on demand, report it to the Guard or Station Master. They will help you.

(Inserted in the interests of Travelling Public)



Engine Lathe Model DLNE with copying attachment MULTICOP.

mounting multiple tool holder and recessing tools.

DIMENSIONS

height of centres	250/280/305 mm	10"/11"/12"
swing over bedway	495/555/605 mm	19 1/2"/22"/ 23 3/4"
swing over gap	720/780/830 mm	28 3/8"/ 30 3/4"/ 32 5/8"
18 main spindle speeds row I		12—600 rpm
18 main spindle speeds row II		15—750 rpm
18 main spindle speeds row III		19—935 rpm
power requirements		7,5 / 10 HP

distance between centres
1000—1500—2000—2500 and 3000 mm
40" 60" 80" 100" and 120"

RAILWAY STOCK FROM AUSTRALIA

Twelve diesel rail cars and 460 unassembled rail wagons have arrived from Australia for the Indian Railways.

They have now been unloaded from the chartered freighter "Belkarin" at Madras, where the rail wagons are being assembled and the rail cars prepared for service in the Indian Railways workshops.

Two Australian experts, Mr. S. Dick and Mr. I. Macfarlane, are in Madras to assist with this task.

The shipment is the second major delivery in a Colombo Plan project under which Australia is supplying India with 24 complete rail cars and 2,000 unassembled rail wagons.

The first major shipment—560 rail wagons—reached India in July last year, and delivery has thus reached the half-way stage.

The other 12 rail cars and the rest of the rail wagons are expected to be delivered towards the middle of this year.

Each of the rail cars is valued at approximately £ A 60,000 (Rs. 6 lakhs).

The rail cars are of broad gauge, 72 feet long and 10½ feet wide, with seating for 82 passengers. They have double-end drivers controls, and each car is powered with two 200 B. H. P. Leyland horizontal diesel engines driving through fluid couplings and four-speed epicyclic gearboxes on the inner axle of each bogie. Their top speed is 80 m. p. h.

It is understood that the rail cars will be used on feeder services by Southern Railways.

This whole Colombo plan project is designed to assist the development of the Indian railways system as part of the Second Five Year Plan. The total cost is approximately £ A 4 million (about Rs. 4 crores).

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I, T. S. Sundar Rao hereby declare that the particulars given above are true to the best of my knowledge and belief.

(Sd.) **T. S. Sundar Rao**
Signature of Publisher.

SOUTHERN RAILWAYS MAGAZINE

INDIAN RAILWAYS HOSPITAL SUPPLEMENT

Vol. IX No. 10 APRIL 1958 Price 25 nP.

CONTENTS

Editorial Notice

The Editor invites contributions to the Magazine on a variety of topics—short stories, technical features written in simple English understandable to the laymen, Aspects of Railway Working, places of tourist interest, News from home line, activities on Railway Institutes etc. All copy should be brief and typed as far as possible.

Photographs illustrating social functions, sports events, scenic sports etc. are also invited. All contributions should reach the Editor not later than 5th of each month. Rejected Mss. will be returned provided sufficient stamps for postage are enclosed. No responsibility will be borne for copy lost in transit.

Views expressed in this Magazine should not be taken as having official authority.

All correspondence should be addressed to the Editor, "Southern Railways Magazine," Post Box No. 17, Tanjore, (South India).

World's Railroad Men are Schooled in Diesel Operation at U. S. Plant

REPRESENTATIVES of the world's leading railroads are going back to school to learn about the newest type of locomotive equipment in use to day.

From as far as Turkey, South Africa, Indonesia, Pakistan and Latin America, railway engineers and supervisory personnel are attending courses here, where a school in diesel-electric locomotive operation and maintenance convenes periodically, Globe Press Service reports.

Two Indian engineers also attended a ten-week course at Erie about a year ago. They were from the Indian Iron & Steel Corporation which purchased some 80-ton GE diesel-electric locomotives.

Erie is the site of General Electric (U. S. A.) Company's Locomotive & Car Equipment Department, manufacturer of the new universal diesel-electric locomotive which is in use in many countries throughout the world. The "students" are employees of railroads that have purchased this revolutionary application of diesel-electric motive power.

GE established the school as a service to its customers. The courses cover every phase of diesel-electric operation and maintenance. There is no "tuition" the men pay only travelling and living expenses.

According to GE, "customers sending representatives to these schools benefit in many ways. Trained graduates know how to reduce maintenance costs through sound maintenance procedures. They learn how to keep locomotives at peak operating efficiency, with the result that there is a high availability of locomotive equipment at all times. Graduates of the school become more satisfied employees, too. They appreciate the fact that their companies have faith in them and they reflect this faith by doing a better job in operating and maintaining valuable railway equipment."

The current universal locomotive school got underway in early January. Among the students are 22 representatives of the South African Railways System—the largest railway system in Africa both in volume of traffic carried and total route miles.

SAR recently purchased 45 Model U12B universal locomotives of 1200-hp., which will be delivered early in 1958.

Two of the South African representatives, both senior engineers, will attend the course from start to finish. The others will study only those subjects pertaining to their specialities.

As part of their course, the men will receive not only classroom training but also instruction right on the GE assembly line. An important phase of the teaching program is the dismantling and re-assembling of a diesel engine.

Field trips will be made by the students to other U. S. companies supplying components for the universal diesel-electrics, as well as to representative American railroad shops.

The school at Erie is only half of the training the men will receive. Later this year, a GE service engineer will take up residence in South Africa to supervise putting the locomotives in operation. When the 22 SAR representatives return from the U. S. they will work under the GE service engineer in the actual operation of the locomotives and will help train fellow employees in maintenance of the new equipment.

This American artist's conception shows the possible shape of New York and other metropolitan transportation in years to come. Future commuters will travel to downtown areas on a smooth, coordinated transportation system. In this coordinated system, which transportation experts predict will alleviate growing traffic congestion, commuters will be able to go where and when they want, quickly and conveniently.

GOLDEN RULES OF CONDUCT FOR RAILWAYMEN

1. Do you plan your work daily? Get the more essential things done first and do not neglect the important ones sidetracting them to the fag end of the day.

2. Do not express casually careless opinion. Never venture forth an opinion unless asked for it.

3. Remember that most of our mental worries come either from trying to fight life hard or from trying to run away from life. Do neither.

4. Learn to accept people as they are, love them, respect them, praise them, encourage them, differ with them, but above all, learn the priceless art of give and take.

5. Cry neither for the moon, nor over spilt milk.

6. Accept the things that you cannot change; have the courage to change the things that you can, and possess the wisdom to know the difference.

7. Do not drive too hard a bargain with yourself.

8. Accept life as it is—its wonders, changes, disappointments, frustrations etc., etc.

Products of the Hungarian Railway Carriage and Machine Works, GYŐR—Hungary

THE Hungarian Railway Carriage and Machine Works were established 60 years ago in an ancient industrial and cultural center of Hungary, and in the course of time developed into one of the most important works of the country. The works have displayed successful export activity from the beginning and it is worth mentioning that about 40% of the 45.000 various railway coaches manufactured in the last 60 years were exported to all parts of the world, making a name also for other products, such as cranes, bridges, steel constructions, etc.

The successful start of the works is revealed by the fact that in 1897, the year following their foundation, rapid progress was guaranteed by orders for several hundred railway coaches. This was followed by continuously increasing orders, for export, which still takes up a considerable part of the factory's production.

As a curiosity it has to be emphasized that in 1906 the passenger cars of the London Underground Railway were supplied by the Hungarian Railway Carriage and Machine Works. These cars, having been in many regards ahead of their times, were built with all-steel frames and in a sheeted body construction.

The up-to-date execution and excellent quality of already the first railway carriages, as well as the correct observance of delivery dates, acquired such reputation for the works, that their export activity could be continuously extended to further countries and railway association. For the past decades a great part of the export-deliveries was directed to European countries/England, Austria, Belgium, Bulgaria, Czechoslovakia, Germany, Italy, Rumania, Russia and later the Soviet Union and Turkey/but a good many overseas countries were also registered as customers of the works/Argentina, Burma, Chile, Costarica, South Africa, Egypt, East-India, China, etc./and thus the products of the Hungarian Railway Carriage and Machine Works, becoming famous throughout the world, have won full appreciation and a good reputation to the trademark " RABA ".

During World-War II export was broken off and when the war was over the factory was left in ruins.

The year 1945 meant a new stage in its history. In the course of reconstruction the Győr works were not only restored but also enlarged and modernized. Changing over to planned economy, the previous manufacturing program, divided into many branches, was restricted and this ensured the vigorous development of up-to-date wagon-building, which remained

unaltered the main manufacturing branch, based on rich experiences and valuable traditions.

One of the principal customers of late years was the Soviet Union, where the works have been delivering considerable quantities of railway rolling stock, suitable for long distance traffic. For Egypt passenger cars and postal vans of tropical design, with special insulation, were delivered in great numbers.

The International Sleeping Car Society (Wagons Lits) has been one of the constant customers of the works and the dining and sleeping cars delivered there won many praises for the factory.

Keeping up with technical progress the governing idea has been to provide for the highest comfort of passengers on one hand, and to increase the speed of railway vehicles, on the other hand. The Hungarian Railway Carriage and Machine Works, recognizing the importance of these tasks have done their best to ensure that customers' requirements can be adhered to in every way and to this end have designed light-weight passenger cars of many types, where trouble-free running is warranted and the most comfortable accommodation provided for. In the new types tare weight is radically reduced by the use of special steels and light-metals of great solidity for the building of running gear and body frame. Several new methods were initiated in the construction of different components; plastic is applied on an always larger scale in the inner panelling of the coaches and the passenger space is extended by resourceful interior arrangement.

At the new types of bogies, construction and springing had to be such as to spare the track even at a maximum speed of 160 km/h and to ensure trouble-free and smooth running in addition to the comfort of the passengers.

Increasingly exacting demands manifest themselves remarkably regarding the precision required in the qualification of the running features. With a view to base these qualifications on correct measurements carried out with precision instruments, the Hungarian Railway Carriage and Machine Works have designed a special measuring equipment built into a universal measuring car, which serves to testing during operation. The universal measuring car is an invaluable standby for the measuring of the output (speed, acceleration, traction, braking, various oscillations, swingings, etc.) of railway carriages and locomotives, i. e. for the simultaneous recording of different particulars.

The eight-wheel bogie measuring car is provided with a 14-channel electronic measuring equipment, controlled from a control-desk in the measuring room, and a dark room provides for the immediate evaluation of the testing results. The power supply of the whole equipment is secured by a separate generating set and, consequently, the measuring car can be coupled to any train, measuring the running features of the respective locomotive or carriage under way. For the staff of the measuring car full comfort is

600 HP. Diesel Electric locomotive for shunting and light track service. Max. speed 50 miles per hour. For the Czechoslovak and Chinese State Railways.

ensured even for a long distance by 3 sleeping compartments with berths, shower room, lavatory, kitchen and a comfortably furnished parlour.

The universal measuring car facilitates essentially the performance of tests and examinations which up to now have been lengthy and circumstancial or could not be carried out at all. Its application means considerable savings by reducing the time necessary for experiments with new constructions and the time of development. This design contributes greatly to the progress of railway vehicles as a security that the carriages given over to transport service by the Hungarian Railway Carriage and Machine Works on the basis of exact measurings, will satisfy requirements in every respect.

Achievements are to be especially accentuated as to the perfection of sound and heat insulation, heating system suitable for the most severe climate, ventilation system proving satisfactory even under tropical conditions, various types of comfortable seats, up-to-date lighting equipments and tasteful arrangement of the passenger space.

The latest novelty in the scope of ensuring the greatest possible comfort, is the application of a modern, trouble-free air-conditioning equipment, which, independently from exterior temperature secures the permanent regulation of interior temperature and vapour contents.

Besides standard open and covered wagons of normal, broad and small-gauge, great quantities of special wagons were supplied for inland use and for export, such as wagons for the transport of poultry, cattle and pigs, refrigerating cars, fruit-transporting wagons, four and eight-wheel tank wagons for spirits, petroleum, wine, sulphuric acid, etc , ore-wagons and sand dump-cars, special transformer cars, metallurgical cars, i. e. hot-metal ladles and slag ladle cars. Customers' requirements can be fully met also in this respect.

The suburban and tramway power-cars and trailers are manufactured in all-metal construction, according to local conditions. Attention has to be drawn to suburban tramways in the most modern execution.

On the basis of the system Ganz-Jendrassik the Hungarian Railway Carriage and Machine Works have developed the manufacture of Diesel engines. Their manufacturing program comprises Diesel engines of 13.5 cm. cylinder bore, with 2 to 12 cylinders and an output of 45–400 HP.

In the interest of economical manufacturing possibilities the main components are interchangeable and can be easily replaced in engines with different numbers of cylinders. The engines are made also in supercharged execution. For the purposes of power cars underfloor engines of 6 and 12 cylinders are used beside the " V " engines of 6 in-line cylinders and 12 cylinders. The engines, depending on their way of application are made with reversing gear / for ship engines / or with remote-control to electrical plants etc.

To the products of the Hungarian Railway Carriage and Machine Works belongs the 130 HP Diesel Shunting Locomotive for light shunting service. It can be supplied—according to specific requirements—with mechanical or hydraulic power transmission, with 4-stage speed gear, 1435 mm. gauge, 19.5 t weight. This type is manufactured also in another alternative for small gauge with the same output.

For many years the works have been leading manufacturers of bridge, steel constructions, portal–, railway steam– and diesel cranes, special tanks, lever constructions. Export-deliveries of these articles have had an equal share in obtaining well-deserved fame. One of the recent supplies has been the Helwan bridge, the longest one across the Nile.

The Hungarian Railway Carriage and Machine Works with their fine tradition and vast experience have taken particular care to maintain the outstanding reputation for quality and service which has been so long established, winning the confidence and appreciation of their customers throughout the world.

"YL" Class Steam Locomotive Type 2-6-2 with Tender Built for the Indian Railways

THE MAVAG Company (the former Hungarian State Iron, Steel & Machine Works) dating back her activity as far as the seventies of the last century has been supplier of locomotive boilers, steam cylinders, motion gears, wheels & axles, locomotive rigging, etc. to the Indian Railways as early as before the World War No. 2

More recently 40 "YL" Class steam locomotives were delivered for the Indian Railways in 1957.

Characteristic data and main particulars of these locomotives are as follows:

1000 mm. gauge, "YL" Class, 2—6—2 wheel arrangement, with tender. This latter is equipped with two "YTA" Class bogies of 2 axles each.

Boiler: coal-fired, riveted construction, with steel firebox and steel staybolts. The boiler is fitted with superheater, and thermal expansion is allowed for by using hinged aft boiler support. Between the throat plate and the outer firebox back plate 2 arch tubes of 3" dia. extend over the firebox.

Fire hazard is virtually eliminated even under hot climatic conditions prevailing through use of ashpan and spark arrester of appropriate design. The boiler is fed by 2 live steam injectors. The main frame is fabricated plate construction. The frame joints are steel castings secured—similarly to other loose joints —by cold-chipped rivets fitted. Brake hangers on the frame, compensating beam brackets and spring hanger carriers as well as steam cylinders are fastened by bolts of close fit.

Axleloads are balanced by compensating beams also with the trucks.

Pony truck and hind truck are designed with Bissel-system self-aligning side control springs. In front on the locomotive cattle guard is arranged.

The 4th wheel is the driven one. The tyres are made of tough manganese-steel of high hardness. Inner hub faces of driving and coupled wheel centres bearing with the axlebox guides are lined with manganese-steel plates. Driving and coupled axlebox bodies are steel castings with bronze bushes pressed in. Axlebox guides on the axlebox body and frame receive manganese-steel slide plates welded on. Lubrication of the driving axleboxes is accomplished by hard grease bricks.

Wheels of pony truck and hind truck as well as those of the tender are fitted with cylindrical roller bearings. Above the axleboxes both with the locomotive and the tender laminated springs are arranged.

The steam cylinder is of cast iron with renewable liners for the same and for the piston valve.

The steam cylinder is equipped with automatic idling gear, safety valves as well as valve type blow-off device.

No front guide is provided for the piston rod. The crosshead is overhead controlled. Lubrication of the steam cylinder is effected by lubricator through inlet pipe.

The connecting and coupling rods have solid eyes with floating bushes, and are grease lubricated. Against the rod bush faces bronze ring inserts are fitted to the wheel centres.

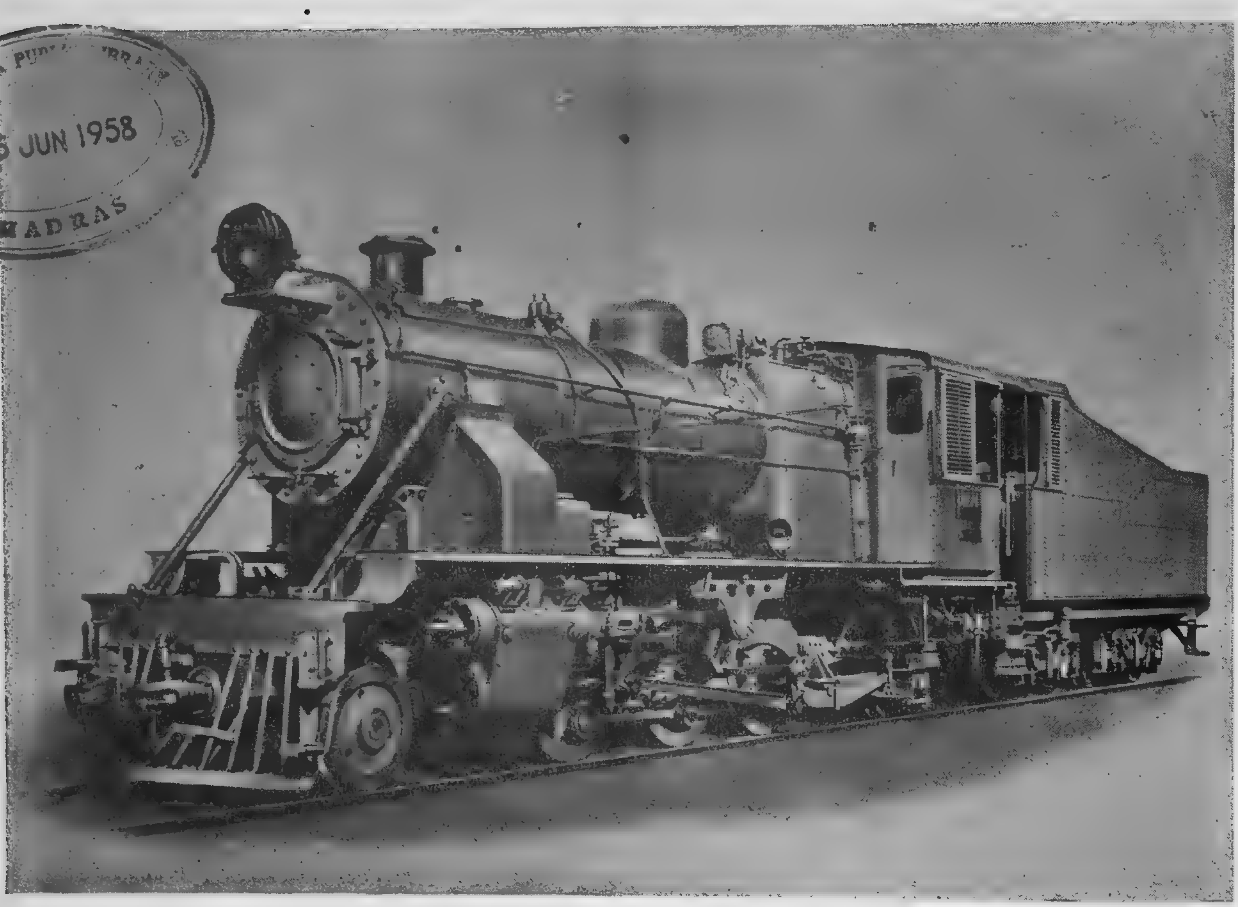
Walschaert's motion is used with piston valve. The eccentric rod big end runs relative to the return crank in roller bearing. Bushed pins of motions rods are case-hardened. Steam stand in cab may be operated by hand wheel through screw spindle.

The loco. is equipped with vacuum brake gear operating through steam ejector. The tender may be braked either by means of the vacuum brake or by applying a hand brake. Belonging to the brake gear a sanding gear is arranged operated by air.

The cab is open only in the rear, towards the tender coal space. Through the door on cab L. H. front wall one may get to the side footplate running all around the locomotive.

Lighting of the locomotive and of the tender is effected by electric current supplied by a turbodynamo.

For drawing purposes buffing and drawgear with automatic couplers are fitted to the locomotive and tender.



Lifting the locomotive and tender may be accomplished by lifting eyes of permanent type.

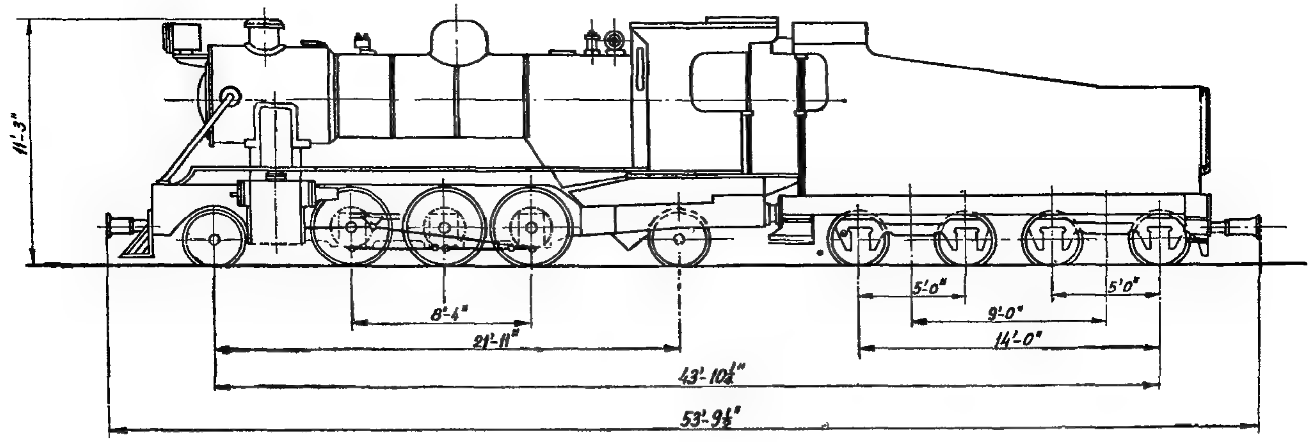
These locomotives as described above were transported from Budapest to Jugoslavia's seaport, Rijeka, dismantled, in 3 railway cars each. Final assembly of the same took place in Rijeka, and then they were forwarded by sea up to Bombay Port in India.

PRINCIPAL DATA

Locomotive

Gauge	1000 mm
Cylinder diameter	$12\frac{1}{4}$ mm
Piston stroke	22 mm
Coupled wheel diameter	43 mm
Running wheel diameter	$28\frac{1}{2}$ mm
Coupled wheel base	100 mm
Total wheelbase	263 mm
Boiler pressure	210 lbs/sq. in

Tubes Nos.	O/S DIA /11 SWG/	$42 \times 2''$
Flues ,,	O/S DIA /8 SWG/	$13 \times 5\frac{1}{4}''$
Arch tubes Nos.	O/S DIA /7 SWG/	$2 \times 3''$
Superheater elements A type Nos.	O/S DIA /9 SWG/	$13 \times 1\frac{3}{8}''$
Heating Surface		
Tubes, sq. ft.		256
Flues, sq. ft.		179
Arch tubes, sq. ft.		8.6
Firebox ,, ,,		78.3
Evaporating, total, sq. ft.		521.9
Superheater ,, ,,		130
Total Heating Surface ,, ,,		651.9
Grate area ,, ,,		17.75
Tractive force @ 85% boiler pressure, lbs.		13.700
Ratio Adhesion to Tractive Force		3.9179
Weight empty		36.7 tons
,, in working order		39 ,,



Axleload	8.0 „
Overall width	102 „
Overall height	135 „
Maximum speed	65 km/hr

Tender

Wheel diameter	28 ½"
Overall wheelbase	168"
Water capacity	3000 gallon
Weight empty	16.4 tons
„ in working order	34.0 „

MAVAG strongly hopes that the Indian State Railways will be entirely satisfied with the locomotives delivered by them and soon they will be able to regard the said Railway Company as one of their buyers of diesel hydraulic or diesel electric locomotives too.

U. K. Steel Company Completes Developments

One of Britain's biggest steel producers, Dorman Long and Company, have just completed their £ 60,000,000 post-war expansion programme.

The last stage was the building of a mill at Lackenby, Yorkshire. It cost £ 18,500,000.

Although commercial output does not begin until July, the mill has already turned out the heaviest steel beam to be rolled in Europe. It weighed 20 tons.

When it is working at full capacity, the plant will be able to produce 400,000 tons of universal beams annually.

The mill's mechanical equipment alone cost well over £ 11,000,000, while its electrical equipment added £ 3,000,000 to the bill. Building and civil engineering work took £ 4,000,000.

Nearly £ 2,000,000 was paid out in dollars in order to bring in mechanical equipment from the United States.

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BRITISH OUTPUT

The output of steel in Britain during March worked out at an average of 432,300 tons a week.

This compares with 427,500 tons in February and 431,000 tons in March last year.

But there was a reduction in the case of the first quarter, with output of steel ingots and castings amounting to 5,475,000 tons this year, against 5,532,000 tons in January–March, 1957.

March output of pig-iron averaged 267,600 tons a week, against 272,700 tons in February and 277,200 tons last March.

This brought the total for the opening three months to 3,516,000 tons, against 3,464,000 tons last year.

Robel's Contribution to Permanent Way Maintenance

ALL equipment, machines and vehicles connected with the *Rail Construction* have changed considerably during the last years. The formerly practised difficult manual work is now reduced to the smallest extent and is today performed with advantageous equipment and by machine work. The operator of the machines has only to bring them to the place where they are needed and to control them resp. to direct them.

Such equipment and machines include for instance:

Rail Loaders of different types and Rail Changers, Rail Sawing—, Drilling-and Grinding Machines, Wooden Sleeper Drilling Machines, Screwing Machines the latter with self-drive by means of a normal petrol engine. There are also Sleeper Drilling Machines and Rail Tooling Equipment driven through a flexible shaft from a small petrol engine or from a side gear such as a Screwing Machine. Furthermore, Gasoline-powered Tie Tampers are in use which—also with a normal small petrol engine—work by the double-stroke system, whereby the operator does not feel any return shock. Some other machines and equipment used for the rail construction, rail reconstruction and the rail maintenance are: Generators, Electrical Equipment, Lighting Equipment, Track Jacks and Rail Windlasses, Carrying Rolls for Points, Monorail Cars, Sighting Devices, Measuring Instruments a. o.

Amongst the excellent 8-wheeled dismountable Small Rail Trucks with large carrying capacity the *Ganger's Railcars* speed up the work on the track considerably. A kind of "Lorry on the Track" especially stands its test through its manifold usefulness. It is equipped with an air-cooled 4-cylinder Diesel motor, with biaxial drive, drivers cabin which can be locked up, loading platform for sleepers, rails and bulk goods and is also suited for the transportation of crews of gangers. With an erected loading crane, with a slewable jib, and with air-pressure brakes for the operation with several trailers all wishes which might exist for such a vehicle should be fulfilled. With another body, two drivers cabins and a liftable and slewable working platform the vehicle mentioned before turns into a *Motorised Tower Rail Truck* for all works on the

Ganger's Railcar R 11

By the use of these vehicles the German Federal Railways have reached important savings of expenses for track construction work.

overhead lines and their dead endings.—For Inspection purposes of the tracks, for accident and emergency services and for the transport of rail gangs *Railcars with pneumatic tyres* are in use, which are equipped with an air-cooled carburettor engine, two drivers stands for forward and reverse drive and a closed box-formed body. The 8-wheeled Small Rail Truck too can be motorised by a gearless motor cycle, whereby the power transmission works through a friction roll to a carrying wheel.

For the *production and the machining of new wooden sleepers* in workshops, which still represent the greatest part of all kinds of sleepers productive machines are required still for many years, regardless of the fact that concrete sleepers have repeatedly gained footing. For the production of new wooden sleepers after the rough cut of the round timber on the saw frame *Multiple Circular Saws* with high working speed and 2 to 5 circular saw blades are used today which work out the blocks into 1 or 2 sleepers and 2 to 4 planks or canted bars. The sleepers correctly lengthened with a *Transverse Circular Saw* will be furnished with the planings for the bearing plates or rails and with the drillings for screws or nails with *Automatic Sleeper Shaping and Drilling Machines.* For this purpose the sleepers will be transported to the belt conveyor with easy running platform cars and will be brought back with very heavy impregnating cars with stanchions. For demands which are not as high simple *Sleeper Recessing and Drilling Machines* (with feed device by

hand) are used; probably movable in order to save transportation expenses for the sleepers.—For switch sleepers an even surface is necessary which cannot be reached with the so called "trueing machine". Only *Switch Sleeper Planing Machines* are used for this purpose which like the metal planing machines work with a table traversing back and forth and which plane 1 or 2 sleepers in one single pass. These machines are also used for old but still useful sleepers.—The many hole patterns of the switch sleepers require *Hanging One-Spindle Drilling Machines* for drillings correctly made with the help of *Drill Gauges* (Jigs). For the drilling the sleepers will be put under the machine on *Roller Brackets with wooden rolls.* In order to relieve the work on the tracks the sleeper screws will preferably be screwed in in the sleeper workshops for which purpose the sleepers will be brought along the *Screwing Machine* with *Roller Brackets.* These are equipped with adjustable multiple disk clutches for the limitation of the torque and can also be used for old but still useful sleepers. For the loading into rail cars *Sleeper Sloping Conveyors* are used which can be manufactured according to the local conditions.

In case of track rebuilding and in order to save expenses the *removed but still useful wooden sleepers* will be overhauled and doweled in *workshops for old sleepers.* For this purpose the sleepers are moved in longitudinal direction on *Roller Brackets* to the different working places. With *Unscrewing Machines* of high torque the screws will be removed; electrical *Locators* will find broken off screw parts or nails. *Sleeper Shaping Machines* with traverse belt conveyors plane the sleepers until the sound wood appears. After this the sleepers will be moved along or askew (on *Cross Roller Brackets* or simple slide spars) to the *Multiple Spindle Drilling Machine* with which the old screw holes will be opened by boring or new holes will be drilled. Dowels will be inserted into the holes opened by boring with *Hydraulic Dowel Presses.* The further machining is the same as for new sleepers.

Besides of the afore mentioned machines for sleeper workshops there are still many other competent machines as for instance: Sleeper Presses for closing ranks, Drilling—, Screwing—and Dismounting Machines for Coupled Sleepers, Conveyors for small iron parts etc., Suction Plants for chips a. o.

In steel works for *new rails* and in rail machining workshops *Circular Cold Sawing—and Multiple Spindle Drilling Machines,* as single or double

machines are not dispensable. In only one process they cut the rail ends and are drilling 2 to 4 fish plate holes. Hole patterns of all kind are adjustable with articulated spindles. Special attention must be called to the half-automatic working of these machines with hydraulic feed motion. If old rails have to be made useful again the ends will be cut with a single *Circular Cold Saw*. After the upset welding of the different pieces of rails the so to speak "endless" rail can then be moved to a different variation of the above mentioned machine, which consists of a Circular Saw and two Drilling Groups. With this equipment the two rail ends can be ready cut and drilled in only one working process. For the bending of curved rails *Roller Rail Bending* Machines with mostly 4 rolls and for less high demands with 3 rolls are used. In case that old but still useful rails—mostly horizontal—have to be bended the *Ram Type Rail Bending Machine* is used which works with a mechanical driven back and forth moving ram. In case the rails have to be bended vertical and (in case of large length) should not be turned *Hydraulic Rail Bending Presses* can be recommended, a variation of which bends the rails in all four directions. For longitudinal displacement of rails—also those with reinforcements—*Rail Progressive Roller Blocks* controlled with one lever are used which with their electro-hydraulic gear serve all conveniences like Forward-Stop-Back as well as fast and slow creeping speed. The following additional machines are used too: Rail Joint Planing Machines, Grinding Machines the latter equipped with flexible shaft as well as accessories like: Sharpening Machines for Saw Blades, Grinding Machines for Spiral Drills or Roller Brackets, Measuring Instruments a. o.

Mines generally have very expanded tracks and are interested in all machines and equipment connected with sleepers and rails. They very often have rails which cannot be used on the tracks anymore. With a Ram Type Rail Bending Machine probably already available for the bending of rails these not useful rails can be brought into the required form in order to serve as pit arches. For the transportation into the pits the arches are cut into 2 or 3 pieces and are provided with fish bolt holes. For this purpose a *Circular Cold Sawing and Multiple Spindle Drilling Machine for Pit Timbering Arches* can be recommended with which all other profiles too can be cut and drilled.

Producer of the afore mentioned machines is Messrs. ROBEL & Co., Munich 25, Western Germany.

This firm is producing machines for the Rail Construction since over 50 years and has, therefore, a large experience in this line. The firm employs approx. 500 workers and disposes of modern production machinery. According to their practical construction, their exact finish and according to the use of the best suitable raw material, on which facts the durability depends, the Robel equipment has found a world-wide distribution.

STAINLESS STEEL IMPORT CUT TO REMAIN

It is learnt that a deputation of the All-India Stainless Steel Industries Association, has recently returned disappointed from New Delhi. The Union Minister for Steel, Mines and Fuel, it is understood, has turned down the delegation's plea for minimum imports of 3,000 tons, on the ground of foreign exchange shortage.

The Association had urged the Government to allow imports at the rate of 3,000 tons a year, though the consumption in 1956 indicated an annual rate of about 5,000 tons. According to the present policy, the Government will issue "ad hoc" licences only to such actual users as are manufacturing railway, hospital and motor car equipments. Furniture manufacturers will not be given any licences.

This policy has, however, dealt a great blow to the stainless steel utensil industry, which is facing a grave situation because of non-availability of metal.

A leading stainless steel manufacturing concern in Bombay has decided to close down its factory from June 9, and others are likely to follow suit in the near future. The price of imported stainless steel has risen to Rs. 4.75 per lb., compared with the landed cost of about Rs. 2.50.

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IRON ORE DEPOSITS IN ANDHRA PRADESH

The total iron ore reserves in Andhra State are estimated to be about 430 million tons. The best quality of iron ore having 50 to 65 per cent of iron content is found in district Kurnool which is estimated to have a reserve of 3.7 million tons. The quality of iron ore found in Hyderabad district with 37 to 43 per cent of iron content is estimated to be of the order of 37 million tons. The largest deposit has been traced in Guntur district—296 million tons—with an iron content of 33 to 37 per cent. Of the total reserves in the state, the poorest quality of iron ore with 25 per cent iron content only, is found in the district of Nellore which has 93 million tons of reserve.

INDIAN RAILWAYS HOSPITAL SUPPLEMENT

CONTENTS

EASTERN RAILWAY HOSPITAL SECTION

Notes on the medical facilities available on the Eastern Railway

HOSPITALS

THERE are 10 hospitals with a total of 508 beds at present. The beds are to be increased to 880 during the second five year plan period as below—

	Existing hospitals	Existing No. of beds	Proposed beds in the second five year plan
1.	B. R. Singh Hospital, Sealdah	123	200
2.	Kanchrapara Hospital	70	85
3.	Howrah Hospital	12	100
4.	Lillooah Hospital	24	40
5.	Asansol Hospital	56	100
6.	Dhanbad Hospital	34	54
7.	Jamalpur Hospital	89	105
8.	Dinapore Hospital	66	116
9.	Gaya Hospital	12	40
10.	Moghalsarai Hospital	22	40
		508	880

Female Ward in our Hospital.

(1) Building to accommodate 16 additional beds at Jamalpur is almost nearing completion. Equipment is being arranged.

(2) Works of construction of 50 bedded hospital at Howrah included in programme for 1957-58. Final approval of site by the Railway Board is awaited.

Male Ward in our Hospital.

Male Ward in our Hospital.

(3) Plans have been prepared for extension at Lillooah and work is expected to be completed during the financial year 1957-58.

(4) Extension of B. R. Singh Hospital buildings to increase accommodation approved, and work included in programme for 1958-59.

(5) Works connected with extension of buildings at Dinapore are in progress and that at Dhanbad are expected to be taken on hand very shortly.

(6) Work at Kanchrapara will be commenced shortly and completed during current financial year.

(7) Plans ready for Moghalsarai and programmed for year 1958-59.

(8) Plans are being finalised for hospital buildings for Asansol and Gaya and it is proposed to include these works in programme for 1959-60.

Operation in progress.

Child under examination.

Pathologist at his Microscope.

Dentist at work.

DISPENSARIES

There are 58 dispensaries. Of these, 4 are attached to workshops and 1 to plant depot. There are 4 lock-up dispensaries at Koilaghat, Fairlie Place, Patna Jn. and Dakhineswar.

Addition of 11 new dispensaries to be called 'Health Units' in future, have been programmed for during the remaining portion of the second five year plan period at the following stations—

(1) Katwa
(2) Bhagalpur
(3) Jamalpur (Rampur colony)
(4) Barhawara
(5) Khana
(6) Ondal workshop
(7) Ondal (between 12 and 13 colony)
(8) Hazaribagh
(9) Garhwa Road
(10) Santhia, and
(11) Beldanga.

Of these, work for the ones at Ondal workshop and Katwa are in progress.

MATERNITY & CHILD WELFARE SERVICES

5 centres in charge of Health Visitors and 16 in charge of Midwives were functioning under the auspices of the Staff Benefit Fund.

Call at Home.

Our Hospital at Jamalpur.

Another of our Hospitals.

Construction of buildings for 3 centres—one each at Kanchrapara, Ondal and Howrah—have been programmed for. Of these, work for the one at Kanchrapara is in progress.

T. B. Ward at Jamalpur.

Operation in Air-conditioned.

Provision of skeleton facilities for institutional midwifery at important centres and at selected isolated centres is being planned and programmed for and expected to be completed during the 2nd plan period.

LADY DOCTORS

Lady doctors have been appointed at all important divisional, workshop and sub-centres.

Post of a Lady doctor at Howrah has been created and posting orders issued to a candidate who is expected to join soon.

The strength of Lady doctors at Sealdah has been increased to cope up with increasing volume of work in the outdoor and indoor sections.

DENTAL CLINICS

Dental clinics were functioning at all centres except Moghalsarai and Gaya till about April '57. Clinics have been opened at these two stations also since then, and are doing useful work.

Proposal for replacement of the Honorary part-time Dentist at Sealdah by a whole-time paid Dental Surgeon will be implemented very shortly as soon as the candidate selected as Dental Surgeon reports for duty. A general nurse has already been posted against the newly created post of Dental Nurse as trained dental nurses are as yet unavailable in the country.

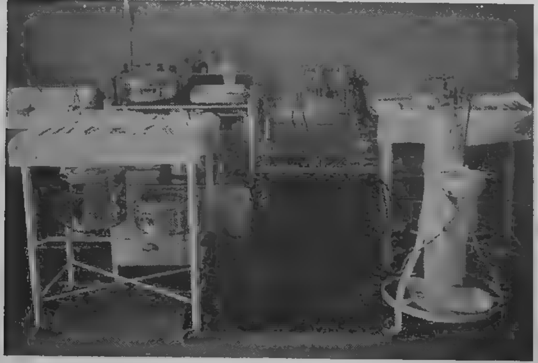
CHEST CLINICS

Chest clinics in charge of part-time honorary doctors were functioning at 5 centres, when these centres were being run under the auspices of the Staff Benefit Fund. From early 1957, the clinics have been increased to 10 (Sealdah, Kanchrapara, Howrah, Lillooah, Jamalpur, Asansol, Dhanbad, Dinapore, Moghalsarai and Gaya). There are 4 Assistant Surgeons in charge of these clinics visiting these clinics in rotation and arranging for special treatment of the cases. About a hundred add employees also

Our Hospital at Sealdah.

Operation Theatre.

Patients in waiting.



Operation Theatre.

Blood Pressure test.

have been successfully treated at these clinics and the disease arrested without recourse to sanatorium treatment, have resumed duty during the period after re-organisation (from May, 1957 to December 1957).

Blood transfusion.

A larger number of family members and entitled dependents have also been similarly treated and the disease arrested.

Instructions have been issued for the complete investigation of contacts for evidence of infection and for the suitable management of infected contacts, as well as for the protection by B. C. G. vaccination of so far uninfected, but susceptible contacts. As controversy about B. C. G. vaccination still exists, it will not be forced upon those who are not volunteers.

PREVENTION OF SPREAD OF TUBERCULOSIS

Three camera units one each for Jamalpur, Asansol and Dinapore have been provided so that, with the existing mass miniature radiographic plant at Sealdah, mass miniature X-ray photographs can now be taken at 4 centres on this Railway for screening all new entrants to exclude infected ones.

(f) Reservation of beds for the treatment of Tuberculosis :

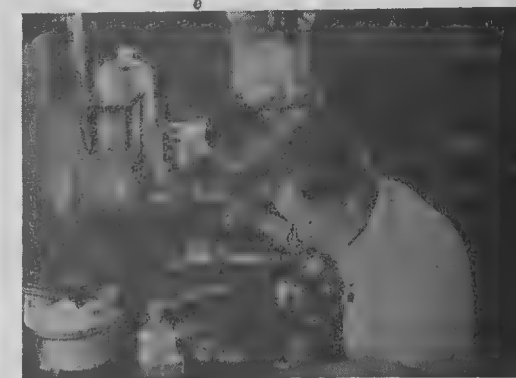
Prior to 1952-53, 23 beds were reserved by the Staff Benefit Fund in different sanatoria for the treatment of cases suffering from Tuberculosis.

In 1954-55, sanction of the Board for the reservation of 24 beds at the K. S. Ray T. B. Hospital, was received on Revenue account of which 12 beds have been handed over to the South Eastern Railway on the bifurcation of the old Eastern Railway. In 1955-56, another 20 beds (15 at Pendra Road Sanatorium and 5 at R. K. Mission Sanatorium, Ranchi) were reserved from Revenue. The Board have sanctioned reservation of additional 100 beds from 1.4.57 for a period of one year from Revenue at the following sanatoria—

1.	K. S. Ray T. B. Hospital	25 beds.
2.	S. B. Dey Sanatorium	20 beds.
3.	R. K. Mission Sanatorium	15 beds.
4.	Mahadevi Birla Sanatorium, Ranchi	20 beds.
5.	Digri Sanatorium	20 beds.
		100 beds.

A lady patient under examination.

The question of reservation of 20 beds at Digri Sanatorium has been abandoned in view of the fact that the maintenance charges for each bed appear to be higher compared to charges made in other sanatoria where Eastern Railway has reserved beds.



Research in our Hospital.

X'Ray Department.

With regard to the reservation of additional 10 beds at Pendra Road Sanatorium, the reply to the Board's query as to the reason for increased rate of charges in comparison with the rates previously charged by them for the reservation of 15 beds in their sanatorium has since been submitted, and their sanction is awaited.

The sanction of the Board for the reservation of 25 beds at Jagjiwan Sanatorium, Dehri-on-Sone at a non-recurring expenditure of Rs. 70,000/— and a recurring expenditure of Rs. 1,800/— per bed per annum exclusive of special medicines and charges for operation and to the extent of Rs. 200/— per annum per bed for special medicine has been received. The negotiation for the reservation of these beds is not yet completed.

DETAILS OF HOSPITALS ON THE EASTERN RAILWAY

Hospitals	Under charge of	Number of Rly. employees served	Number of beds	Number of in-patients treated	Annual recurring cost (in thousands of rupees) Staff	Drugs	Others
1	2	3	4	5	6a	6b	6c
B. R. Singh Hospital, Sealdah.	Divl. Medical Officer	20,598	123	3,944	1,95.0	40.0	8.0
Kanchrapara Rly. Hospital.	Workshop Medical Officer	17,502	70	2,687	1,16.0	23.0	4.0
Howrah Rly. Hospital.	Divl. Medical Officer	22,504	12	238	52.0	10.0	2.0
Lillooah Rly. Hospital.	Workshop Medical Officer	13,388	32	1,569	70.0	16.0	2.0
Jamalpur Hospital.	Workshop Medical Officer	22,319	89	4,817	142.0	26.0	5.0
Asansol Hospital.	Divl. Medical Officer	33,421	56	1,640	106.0	20.0	3.5
Dhanbad Hospital.	Asstt. Medical Officer	14,271	34	2,064	80.0	18.0	3.0
Dinapore Hospital.	Divl. Medical Officer	24,673	66	2,242	1,14.0	21.0	3.5
Gaya Hospital.	Asstt. Medical Officer	5,911	12	684	53.0	12.0	2.5
Mughalsarai Hospital.	Asstt. Medical Officer	7,520	22	1,526	68.0	15.0	2.0

(The particulars submitted relate to the year ending 31st March 1957.)

The number of beds available on the Eastern Railway for the treatment of employees and the members of their families on date in various sanatoria together with the beds which were formerly reserved from the Staff Benefit Fund (since taken over on the Revenue) is as follows—

Name of Hospital	Beds under S. B. Fund	Beds under Revenue	Total
1. K. S. Ray T. B. Hospital, Jadavpur	11	37	48
2. S. B. Dey Sanatorium, Kurseong	2	20	22
3. R. K. Mission Sanatorium, Ranchi	5	10	15
4. Madar Union Sanatorium, Ajmere	5	—	5
5. Pendra Road Sanatorium, Pendra	—	15	15
6. Mahadebi Birla Sanatorium, Ranchi	—	20	20
	23	102	125

Proposal for the establishment of a separate Tuberculosis Hospital (Sanatorium) at Piska in Bihar, in lieu of reservation of beds in various sanatoria, has already been submitted to the Railway Board and the decision of the Board is awaited.

SPECIALIST SERVICES

4 posts of whole-time paid specialists—2 gazetted A. M. O. (Class II)—in radiology and anesthesiology and 2 non-gazetted Assistant Surgeons, Gr. I (Eye and E. N. T.) have been created. The Railway Board have to post candidates to fill up the gazetted posts. Arrangements are on hand to post on an Ophthalmologist. A suitable candidate for filling up the post of E. N. T. specialist has not become available so far. It may be necessary to convert the same into a class II gazetted post to attract persons of merit.

Approval of the Board has been received, to obtain the services of three eminent specialists (Cardiology, Orthapaedics and Gynaecology) as part-time honorary visiting consultants at the B. R. Singh Hospital. The formal approval of the West Bengal Government is awaited by these incumbents to take up the posts.

MOBILE DISPENSARY

Two mobile dispensaries have been sanctioned for this Railway by the Railway Board. The construction of one is nearing completion and it is proposed to put the same into commission at an early date. The construction of the second mobile dispensary will be taken up shortly after the present one under construction is turned out completed. It is proposed to run the first mobile dispensary on the Bandel, Azimganj, Azinganj-Nalhati and Barharwa-Khana sections.

SANITATION

The control of sanitation of all important stations on this railway, where railway doctors or sanitary inspectors are posted, has been taken over from the Engineering department as the Board have since decided that the control of sanitation is the responsibility of the Medical Department.

The control of sanitation of road-side stations is the responsibility of the Operating Deptt.

PREVENTIVE MEASURES

The post of a D. M. O. (Health) has been sanctioned by the Railway Board with a view to look after the preventive aspect of the disease so as to create condition under which the railway staff and their families develop a positive health and do not get a disease.

AGE LIMIT ON STUDENTS' CONCESSION TICKETS

The Railway Board have imposed an age limit on persons who should in future be regarded as eligible for suburban and non-suburban student concession tickets at concession rates. With effect from May 1, 1958, such student concession tickets will be available only to students who are not more than 25 years of age.

Medical Facilities and Public Health Activities at Chittaranjan

By Dr. D. B. Sen, District Medical Officer.

IF it is true that the average railwayman enjoys better medical facilities than his other compatriots, then it can be stated without exaggeration that average railwayman at Chittaranjan enjoys still better facilities than his fellow worker on the Open Line. For instance on the Open Line, there is one railway doctor for every 4000 railwaymen and their dependents, while for general population there is one doctor for every 6000. But at Chittaranjan there is one railway doctor for every 2333.3 railwaymen and their dependents. On the Open Line there are three beds for every 900 railwaymen but for the general population there are three beds for every 10,000; whereas at Chittaranjan there are three beds for every 312 railwaymen.

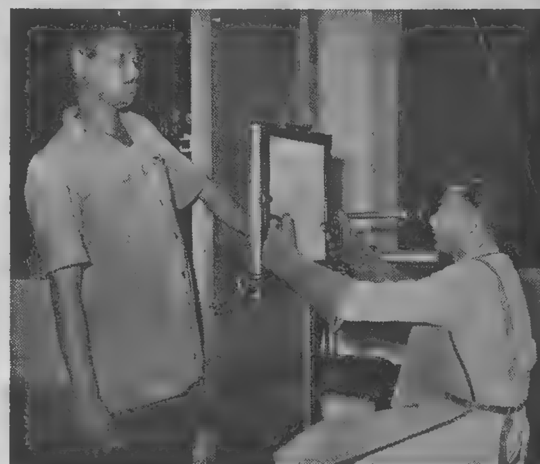
MEDICAL ORGANISATION

Due to rapid augmentation of medical and health amenities for the staff and their families and for effective control of and curative measures against various diseases, particularly malaria and infectious diseases, it has become possible to maintain the general health of the population of this township at a high level.

At Chittaranjan there is a fully equipped modern hospital with 70 beds, four area dispensaries, one health centre and one Ambulance Room inside the Workshop.

Our Pathologist on Culture.

A sum of Rs. 4,49,000 in the year 1956—57 was spent on medical services at Chittaranjan on 7409 employees, thereby devoting a sum of Rs. 60/06 naye paise in 1956—57 per head of staff per annum. Besides medical services, a sum of Rs. 1,50,000 is being spent every year on sanitation and anti-malaria at Chittaranjan.



Screening of a Worker by our Doctor.

Eye Clinic—One of the Assistant Surgeons was sent by this Administration for post-graduate training in Ophthalmology. He has returned after obtaining the Diploma in Ophthalmology and his services are being utilised at the Eye Clinic of the K. G. Hospital, thus fulfilling a long felt need for specialist attention in this respect.

Dental Clinic—The Dental Clinic has been functioning at the Outpatient Department of K. G. Hospital, in-charge of an Asstt. Surgeon, Gr. I (Dental).

Control of tuberculosis—In recent years there has been an alarmingly high incidence of tuberculosis in our country which is attributable to many factors and effective control of this disease has become a matter of great importance and urgency. It has been observed that one of the factors of increased incidence of tuberculosis is rapid Industrialisation and Urbanisation. Particular attention is being paid towards the control and prevention of this disease. All the amenities, such as good housing, lack of

congestion, water borne sewage system, supply of chlorinated filtered water, plenty of open space, etc. have been provided at Chittaranjan. All these substantially contribute towards reducing incidence of tuberculosis.

Total number of 9283 persons of this township were tuberculin tested and 2854 persons were given B. C. G. vaccination. All new entrants are fluoroscopically examined as a routine measure to detect any evidence of tubercular disease of the lungs.

Reservation of beds in T. B. Sanatorium—12 beds have already been reserved in the Kumud Sankar Ray Tuberculosis Hospital, Jadavpur, Calcutta, for treatment of employees and their families. In addition to these 12 beds, six beds for treatment of tuberculosis of lungs are maintained at the Isolation Ward of the K. G. Hospital, Chittaranjan.

Physiotherapy Department of the Kasturba Gandhi Hospital

All cases who could not be admitted either into the K. S. Ray Tuberculosis Hospital, Jadavpur, or at the K. G. Hospital, Chittaranjan, are properly treated from the Outpatient Departments. They are given free all latest antibiotics and other drugs used for treatment of tuberculosis.

Total number of railway employees and their families treated during 1956—57 and number of cases in whom the disease was arrested :

	Incidence		1956—57
(a)	Fresh cases	—Employees	30
		Families	24
		Total	54
(b)	Old cases	—Employees	34
		Families	19
		Total	53
(c)	Total cases of Tuberculosis under treatment at Railway Hospital	—Employees	64
		Families	43
		Total	107
(d)	Number cured	—Employees	31
		Families	1
		Total	32

The Chest Clinic attached to the Kasturba Gandhi Hospital has been functioning in-charge of a Asstt. Surgeon Gr. I who possesses the Diploma in Tubercular Diseases diploma of T. D. D. He is being assisted by the Tuberculosis Health Visitor. One Radiographic Camera Unit at the cost of Rs. 30,000 has been purchased and will be utilised for the chest clinic attached to the K. G. Hospital. Some statistical figures of the Medical Department for the year 1956—57 are given below :

	1956—57
No. of new cases treated in the Outpatient Deptts.	58,827
No. of total attendance in the Outpatient Deptts.	1,64,029
No. of new admission in the K. G. Hospital	2,362
No. of maternity cases confined in K. G. Hospital	559
No. of X-Ray Screening done	3,922
No. of X-Ray plates taken	885
Total cases treated in Electro Therapy Deptt.	534
Total No. of specimen examined at the Laboratory, K. G. Hospital	13,671
Total No. of Bacteriological analysis of drinking water done at the Laboratory, K. G. Hospital	88

Health-Centre—Amladahi Health Centre has been primarily functioning as Maternity and Child Welfare Centre. A Lady Asstt. Surgeon is incharge of this clinic and two midwives and two Ahyas are attached to this health centre. All

expectant mothers are regularly examined and, necessary treatment is given with proper advices. All records are maintained on special cards for this purpose. Domiciliary midwifery service is also given to family members of employees.

A Junior Maternity Nurse is also posted at the Sundarpahari East Dispensary to render domiciliary midwifery service to family members of employees residing in Sundarpahari East, Sundarpahari North and Hill Colonies and other colonies, if necessary

	No. of Home Confinements. 1956—57.
(a) By midwives attached to the Amladahi Health Centre	135
(b) By Junior Nurse attached to the Sundarpahari East Dispensary	75

The Kasturba Gandhi Hospital — A Front View.

Family Planning activities—A Lady Assistant Surgeon is in-charge of the Family Planning Scheme at Chittaranjan. She has undergone a special short course of training in Family Planning under the Family Planning Association of India (West Bengal Branch). Instructions in this regard are being given by her at the Amladahi Health Centre as well as in the Female Outpatient Department of the K. G. Hospital. Contraceptives have been purchased from a grant of Staff Benefit Fund Committee for this purpose and are stocked by the Medical Department. These are sold at a very cheap rate to the employees of this Administration. Another Assistant Surgeon, Grade I of this hospital who was sent to Bombay for a special course of training for 2 months in Family Planning under the Family Planning Training & Research Centre, Sandhurst Road, Bombay, has returned after obtaining the necessary training.

The Maternity Ward.

Sanitation and Public Health—

There has been no incidence of epidemic diseases at Chittaranjan ever since this township was built.

Sanitary Committee—There is a Sanitary Committee at Chittaranjan consisting of District Medical Officer and Town Engineer as Chairman and Secretary respectively. This committee are responsible for the initiation and execution of sanitary and public health schemes of this township.

This committee make periodical inspection of all the markets in Chittaranjan including eating houses, stalls and public buildings. The committee also inspect all cooked food stuffs sold in these eating houses and other food articles, such as ghee, oil and butter. Examination of samples of ghee, oil and butter are carried out regularly at the Laboratory of the Chemist & Metallurgist, Chittaranjan. The committee also inspect the township with regard to the general cleanliness, sanitation and drainage, etc.

Samples of drinking water are taken from different areas of this township periodically for bacteriological analysis which is carried out at the Pathological Laboratory of the K. G. Hospital. Chemical analysis of water is also carried out at the Laboratory of Chemist and Metallurgist, Chittaranjan.

Anti-malaria measures—Incidence of malaria in this township has been controlled as a result of effective antimalaria measures undertaken by this Administration.

—	No. of Malaria cases.	Percentage to staff (Malaria).
1956—57	7	.04%

St. John Ambulance Association—Regular classes in "First-Aid to the injured" are held in the Ambulance Room to enable the employees to attend these classes conveniently and to get themselves trained in first-aid to the injured.

	1956—57
No. of classes in First-Aid	9
No. of candidates receiving instructions	134
No. appearing for examination	103
No. obtaining certificates	60
Total No. of those trained in first-aid up-to-date.	263

Staff Benefit Fund Committee—Financial assistance for nourishing diet is rendered to employees for themselves or for their dependent family members who are suffering from tuberculosis.

During the year 1956—57, a sum of Rs. 7,380/— has been sanctioned to staff and their family members from the Staff Benefit Fund who are suffering from tuberculosis.

Industrial Hazards—

An Accident Prevention Committee was formed to explore every possible ways and means to prevent accident in the workshop and to educate staff with a view to making them accident conscious.

This committee meet regularly. They go round the various shops. They analyse various statistical figures in connection with accidents and recommend such measures as are considered necessary to prevent recurrence.

All staff who are liable to get chronic lead poisoning are periodically examined. All records in this connection are maintained.

Big posters have been placed in conspicuous places inside the Workshop depicting instructions how to prevent accident.

The cause of every accident, other than minor ones, is thoroughly investigated by the Assistant Production Engineers with a view to arriving at a conclusion whether the same is purely accidental or due to carelessness & negligence and appropriate measures are taken to avoid recurrence.

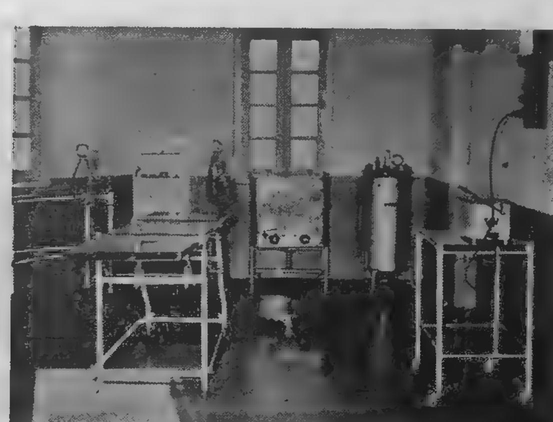
NORTH FRONTIER RAILWAY HOSPITAL SECTION

New Hospital building at Alipurduar Jn.

It is 34 bedded Hospital. Alipurduar Jn. is in Jalpaiguri district (West Bengal). It is a junction station for Cooch-behar-Gitaldah section on East Pakistan Border. It may be called a gate-way of Assam. It was once highly malarious station.

New Railway Hospital at Siliguri Jn.

It is a 16 bedded Hospital opened in November, 30th 1957. Siliguri Jn. is in Darjeeling District (West Bengal) and is an important traffic modal point. It is a junction station. The narrow gauge line to hill station Darjeeling starts from here. The station is situated on foot hill area (Terai area) which was once notoriously malarious.



Inside view of the operation theatre of Siliguri Hospital.

CENTRAL RAILWAY HOSPITAL SECTION

CENTRAL RAILWAY HOSPITALS

THE total number of Hospitals provided on this Railway for treatment of employees and their family members is 12 (twelve) and the number of beds provided therein is 486 (Four hundred, eighty six) as under:

Hospitals	Number of beds provided
Byculla	86
Bhusawal	82
Jabalpur	21
Nagpur	20
Jhansi	48
Sholapur	10
Lallaguda	120
Kazipeth	6
Purna	6
Igatpuri	45
Bina	12
Kurduwadi	30
Total:	486

Igatpuri Hospital, inside view.

2. The proportion of beds provided is one bed for 376 employees. One hundred and five per cent of the total number of beds were occupied per day in the year 1956—57.

3. Byculla Hospital is treated as Headquarters hospital and the cases requiring specialists consultation from other district Hospitals are referred to this Hospital for admission and investigation.

4. Eminent specialists as Honorary consultants have been appointed at Headquarters Hospital Byculla as under :—

   1. Physician
   2. Orthopaedic Surgery
   3. E. N. & T. Specialist
   4. Opthalmologist (to be appointed) (from 1—4—58)

5. The modern medical and surgical facilities have been provided at all District Hospitals. Chest Clinics have been established at all District Hospitals. A Dental Clinic has

Operation Theatre Byculla Hospital.

Igatpuri Hospital.

been established at Byculla Hospital in charge of a full time Dental Surgeon. Honorary Dental Surgeons have been appointed at Bhusawal, Jhansi, Jabalpur, Nagpur, Sholapur and Lallaguda Hospitals.

6. To attain the plan target of Railways for the provision of 5 beds per thousand of employees by the end of Second Five Year Plan, additional beds are being provided by provision of New Hospitals or by carrying out additions and alterations to the existing Hospital buildings.

ALUMINIUM PLANT FOR KERALA

Kerala will have an aluminium manufacturing plant with 10,000 ton annual production capacity, to be established shortly with the technical assistance of a Hungarian firm. Mr. L. Oliser, representative of the Nikex Foreign Trade Company, Hungary, who had already visited Kerala to study the possibilities of giving help to start new industries and help discussions with the Ministers and officials of the Government and industrialists in the State, stated that it had not been decided as to whether the plan would be in the private or public sector.

WESTERN RAILWAY HOSPITAL SECTION

HOSPITALS ON WESTERN RAILWAY

DIVISIONAL HOSPITALS

There are two large hospitals on this Railway.

(1) LADY JACKSON MEMORIAL HOSPITAL, DOHAD

This is a fully equipped hospital with a bed strength of 75. This hospital is situated on a hill, a couple of miles away from the hustle and bustle of Railway Workshops area and main residential colony. It has beautiful lawns and gardens all around and commands a bird's eye view of the whole Railway colony at Dohad. It was declared open in 1930 with a bed strength of 50 which at present is raised to 75. It has general and special, male and female, medical and surgical wards and isolation ward and a well equipped air-conditioned operation theatre. The radiodiagnostic unit in this hospital has one static 100 MA x-ray plant with camera unit attachment and a 15 MA portable x-ray unit. Electrotherapy unit has a short wave diathermy, ultra-violet and infra-red apparatuses and a pantostat. A pathological laboratory equipped for undertaking bio-chemical, bacteriological and pathological investigation is also provided. For opthalmological investigations and visual acuity tests, a dark room with all necessary equipment is provided. Recreation room for indoor patients with facilities for indoor games like cards, chess, carrom, etc. and newspapers, periodical and illustrated magazines and a radio has been lately added as an additional amenity to the sick railway patients.

DMO taking a round at the Dohad Hospital, Western Rly.

An outpatient department for this Railway hospital is sited in the heart of the Railway colony, popularly known as D'site. It has a daily attendance of over 600 patients. Domiciliary attendance and care are made available from here and cases needing hospitalisation are sent to the main hospital.

Dohad Hospital Building, Western Railway.

Operation in progress at Dohad Hospital, Western Rly.

The following services are also available :—

(i) Ambulance service for transport of patients all hours of the day and night.

(ii) Blood transfusion service.

(iii) Anti-rabic centre.

(iv) Chest clinic for T. B. patients. (A separate building is under construction and is likely to be completed shortly.)

X-Ray Units at Dohad Hospital, Western Rly.

Ajmer Hospital Building, Western Railway.

(v) Dental clinic manned by a qualified dental surgeon.

(vi) V. D. clinic.

(vii) A new maternity home of 12 beds with facilities for ante-natal and post-natal clinic, family planning centre and a creche has been provided in the heart of the colony near the outpatient department. It is manned by a qualified lady doctor assisted by midwives and other ancillary staff.

(viii) Welfare activities : Milk and patent foods are provided to needy patients. Instructions on family planning are given. Baby shows and tidy house competitions are also arranged.

(2) RAILWAY HOSPITAL AT AJMER

This hospital is the oldest on this Railway. By expansions and additions this hospital has been kept up to date. At present it has an accommodation of 72 beds, and is soon to be increased to 100 beds. It has general and special, male and female wards, medical and surgical wards, a fully equipped air-conditioned operation theatre, diagnostic radiological unit, electrotherapy unit, pathological laboratory and ophthalmological dark room on the same lines as at Dohad Railway hospital.

A separate outpatient department of this hospital has recently been constructed and is just opposite the main hospital building. A new maternity home and an isolation block of 10 beds have been constructed of late and separate chest clinic is to be provided in the near future.

D.M.O. taking a round in Ajmer Hospital, Western Rly.

Additional services in the form of an ambulance service, casualty service, blood transfusion service, anti-rabic centre and dental clinic are provided in this hospital.

The staff at both these hospitals consist of a Divisional Medical Officer, one Assistant Medical Officer (class II), adequate number of Assistant Surgeons for general duties and whole-time specialists in the cadre of Assistant Surgeons for radiology, pathology, anaesthesia and ophthalmological work. A matron, steward, adequate number of nurses, dressers, hospital attendants, ayahs, etc. are provided on the nursing side.

All essential staff are provided with staff quarters near the hospitals to enable their availability with out delay in case of emergencies.

HEADQUARTER HOSPITAL

This is under construction at Bombay with a bed

strength of 150 to start with which is to be increased to 300 in the third five-year plan period. This hospital will incorporate modern facilities for hospitalization and treatment of railway employees and families and will have the following working units :—

(1) Medical Service Unit

(2) Surgical Service Unit and Operating Unit

(3) Maternity & Gynaecological Service Unit

(4) Specialist Service Units consisting of :—

- (a) Radio diagnostic Unit
- (b) Laboratory Unit
- (c) Dental Unit
- (d) Ophthalmic & ENT Unit
- (e) Electro-therapy, physio-therapy and rehabilitation Unit

(5) Resident Service Units consisting of :—

- (a) Outpatient & Admitting Unit
- (b) Emergency & Casualty Unit
- (c) Pharmacy Unit

(6) Nursing Service Unit consisting of :—

- (a) Ward Nursing Unit
- (b) Central Sterilization & Supply Unit
- (c) Catering & Food Service Unit
- (d) Laundry Unit

(7) Administrative Service Unit consisting of :—

- (a) Secretariat Unit
- (b) Social Service Unit
- (c) Stores & Supply Unit

The services of honorary consultant specialists in various branches of medicine and surgery will also be provided.

It is also proposed to provide divisional hospitals with a bed strength of 50 at each divisional headquarters i. e. Baroda, Kotah, Jaipur, Rajkot and Bhavnagar and a 30 bedded hospital at Ratlam. The hospital at Baroda is nearing completion and at other places the buildings are under construction.

Sub-divisional hospitals with bed strength ranging from 10 to 25 beds are also functioning on this Railway at the following stations :—

Lower Parel, Bombay
Bulsar
Gangapur City
Bandikui
Udaipur
Gandhidham
Abu Road

Deluxe Trains Have Ordinary Third Class Coaches Now

With effect from the first week of February, the air-conditioned Deluxe trains running between Delhi and Bombay, Delhi and Calcutta and Delhi and Madras have in their composition ordinary third class coaches as well.

In each of the New Delhi-Bombay Central and New Delhi-Howrah trains there are now two such coaches and in the New Delhi-Madras Central trains there are three ordinary third class coaches.

This arrangement has come into effect on the Delhi-Calcutta run from Howrah on February 4th and from New Delhi on February 5th, on the Delhi-Bombay run from Bombay on February 2nd and from New Delhi on February 3rd, and on the Delhi-Madras run from Madras on February 3rd and from New Delhi on February 5th.

As these trains are the fastest on their respective routes, it means that on these routes, besides abating the overgrowding in third class in the long distance trains, the new arrangement will provide the third class passengers with a substantially faster service than hitherto.

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RAILWAY HOSPITALS ON THE NORTHERN RAILWAY

Hospital — Moradabad

Central Hospital — New Delhi

Central Hospital — New Delhi

HUNGARY SPENDS A MILLION IN BRITAIN AIR CONDITIONING FOR TRAINS

Hungary has signed an agreement with a British firm for the purchase of air-conditioning equipment to be fitted in railway coaches made by the famous Wilhelm Pieck railway carriage works at Gyor, northern Hungary.

The Hungarian News Service in London understands the deal to be worth nearly £ 1,000,000.

The equipment is being bought from Messrs. J. Stone and Co., Ltd. of Deptford.

The Gyor works makes rolling stock for many countries, including the Soviet Union, Egypt, Argentina, Burma and India where good air-conditioning is essential.

Messrs. Stone are to supply about 100 complete sets of equipment, after which it is intended to develop joint manufacturing of further equipment under licence. The British firm will send technicians to advise the Hungarian works.

Mr. Albert Lakatos, general manager of the Gyor plant, who has been in London for the last few weeks with the negotiating team, said: "The Stone equipment is regarded everywhere as the best in the world. That is why we have come to London.

"We have agreements to supply carriages to many countries, so a high technical level in the functioning of the coaches is a matter of importance to us.

"Stone experts were many times in Gyor and have seen our highly developed production process and I think that the co-operation between Hungarian and British experts will be useful for both sides in the future."

The Gyor plant employs 8,000 workers and about 65% of its output is exported.

Common Hygienic Measures for Prevention of Disease

By A Doctor

"Health is the greatest of gifts. Contentment is the best of riches."

WHAT IS HEALTH

HEALTH is wealth. Sickness is a scourge on society. Sickness delays the progress of civilization. A sick man is not only a burden to himself but also to his family and society. Some of you might wonder why disease should affect only a few in a community and not all. Germs from sick people are found floating in the air, spread on the ground and mixed in water. All people who breathe polluted air, who walk on disease infested ground and who drink infected water are not equally affected. Those not affected have an inborn resistance or immunity to disease and this is known as *natural immunity.* Some others *acquire immunity.* They have had these diseases while they were young and have become resistant to a second attack. But these people are comparatively few. We will have to make all people resistant to diseases—the worst ones being Tuberculosis and Small-pox. Vaccination will safeguard people against such diseases and thus they become immune—resistance produced by artificial means is known as *artificial immunity.* Those who are not vaccinated easily become victims to these ravaging diseases.

Cleanliness in the home and of person is also responsible for good health. Unclean surroundings and unclean habits produce disease and ill-health not only to oneself but also to one's family. People living in slums fall sick easily. Those who are careless about their food are the constant sufferers of digestive disorders.

Disease germs are transmitted from person to person through air, water, food, personal contacts like fingers, clothes, drinking utensils etc., and also sexual intercourse with infected persons.

DISEASES SPREAD THROUGH AIR AND DUST

Tuberculosis, Whooping-cough, Pneumonia, Diphtheria and Influenza (Flu) are the important diseases which are commonly transmitted by droplets of spit, when the patient coughs or sneezes. Spitting inside buildings is a bad habit and when the spit dries up, the germs get mixed with dirt and dust which float in the air and pollute the whole atmosphere which healthy people breathe and get infected. Small-pox, Chicken-pox and Measles are transmitted through air during the later stages of the disease when the scales or scabs fall off from the body. Close contact and the use of same clothes, towels, food, dining plates and drinking vessels are also responsible for such spread.

Vaccinations or immunization against T. B., Small-pox and Whooping-cough at an early infancy will prevent these dreadful diseases attacking children of the house-hold. The idea of Tuberculosis being produced by injection of B. C. G. vaccine is baseless and wrong. Does vaccination against small-pox, produce small-pox ? Let more people have their children injected with B. C. G. vaccine and in due course we can wipe out Tuberculosis from our country. When there are cases of Whooping-cough or Diphtheria in a locality, it would be of great benefit if other children who come in contact with the sick are immediately inoculated against such diseases. Combined vaccines are available, a single injection of which will give protection against two or more diseases. People should cast off old ideas and progress forward by going in large numbers to public health centres and get vaccinated or inoculated depending on the disease prevalent in the locality.

Disease spreads easily in overcrowded places. Smoke and dust aggravate an attack of Asthma and sneezing in some people. Dust settles on the worker's sweating body, towards the end of hard day's labour and if he is unclean in his habits, he falls a victim to ill health easily. Bathing twice a day once in the early morning and once after returning from work is ideal. But this is not possible due either to water scarcity or want of time. At least the worker should bathe once a day and the ideal time would be soon after his return from work when he is tired, sweating and dirty. He then feels fresh, happy and healthy.

SPREAD THROUGH WATER, MILK AND DIRTY FOOD

Air and dust are not the only carriers of infection.

Milk and water are the close second. Diarrhoea, Dysentery, Cholera, Typhoid, etc. are water borne diseases—spread sometimes like wild fire by drinking infected and polluted water. Dysentery, Intestinal T. B. Septic sore throat, etc., are transmitted by drinking raw, unboiled milk. All these diseases are also carried through infected food, unclean fingers and dirty eating and drinking utensils. Most of you know what ravaging and sinister diseases these are. When once attacked, the person becomes a weakling with no interest in life for a pretty long time. To safeguard yourself and your dear and near ones from getting the diseases the following hygienic measures and precautions should be taken.

1. Drink only boiled water.
2. Drink only boiled milk.
3. Eat only clean food.
4. Wash the vegetables very well with running water before cooking.
5. Eat only well cooked meat.
6. Do not spit inside buildings.
7. Clean your feet before entering your dining rooms. Workmen who work either in the workshop or out doors are mostly bare-footed. Dirt and mud settle on their feet and dirt carries disease germs.
8. Clean your hands before eating your meals.
9. See that nobody defecates around the house, on the sides of the road or inside the house in odd places.

In short lead a clean life and you can keep down your doctor's bills, increase your income by more working days and become more efficient.

SPREAD THROUGH MOSQUITOES, BUGS AND FLIES

However clean a person might be, there are diseases which affect him through the bites of insects, bugs and mosquitoes. The important ones which spread through the bites of mosquitoes are Malaria and Filaria (Elephantiasis). Mosquitoes breed in marshy places, stagnant waters and in dirty

corners of houses where filth and dirt accumulate. They bite a person with Malarial fever or Filarial disease and take in blood. This blood is then injected into a healthy man through its bite and thus the healthy man gets the disease. We must destroy the mosquitoes to prevent the spread of Malaria and Filaria. This is done by destroying their breeding places—by draining the stagnant waters, removing the filth and dirt from the corners and burning the accumulated waste. Adult mosquitoes in the houses can be killed with disinfectants like D. D. T. etc. Individuals can safeguard themselves against the mosquito bites by sleeping under mosquito curtains, if they can afford.

Next to the mosquitoes, flies are the most important insect responsible for the spread of disease. Flies act as mechanical carriers of disease germs—sitting on infected rubbish or faeces vomit or spit and then sitting on the food we take. Thus Typhoid, Dysentery and Cholera are spread from an infected person to a healthy one. Same methods as used to destroy mosquitoes have to be used in case of flies and their breeding places. In addition the eatables and food are to be covered and safeguarded against flies.

SPREAD OF LEPROSY AND SCABIES (ITCHES)

There are two types in Leprosy—Infectious (Lepromatous) and non-infectious (Neural). In the infective variety there are ulcers on the skin and deformity of the body, particularly the face. In the non-infective there is no deformity but there is a depigmented patch seen on the skin. There is also loss of sensation in this patch. The second variety affecting the nerves is non-infectious. The disease of Leprosy does not pass from parent to child as is wrongly believed but the child would be infected if it is in close contact with the mother suffering from the infective type. So to avoid this dreadful disease, the child should be isolated from the infectious parents immediately it is born. Secondly contacts with infectious cases should be avoided. Close contact with persons having scabies (itches) should also be avoided.

VENEREAL DISEASES

Last but not the least important of all, is the spread of Venereal Diseases (V. D.) This is transmitted from person to person by sexual contact with infected persons. If once infected, the disease passes on to their children, for the same blood of the mother nourishes the infant in her womb. The child thus born suffers from this dreadful disease, through no fault of its own. Let men and women think of their children to be born during their weak moments. Those who are affected should get completely treated and the advice of welfare centres sought.

The subject of spread of disease and its prevention is so vast that my treatment of it in this short article is necessarily sketchy. My main object is to infuse into the layman a few ideas about the common diseases and the common methods which could be adopted to prevent their spread.

"Cleanliness is next to Godliness", according to an old adage. Clean surroundings radiate joy. More than that they help in controlling diseases. On Railway Platforms, in Waiting Rooms and in Carriages, etc., where people gather, it is of paramount importance to maintain proper hygienic conditions, to preserve the health of the passengers. You can help the Railways in this fight against diseases by:

Extending your co-operation for keeping the surroundings clean and by availing of the services of Sanitary Staff provided at stations whenever required.

A "PROVINCIAL" SCIENTIST

By Mark Popovsky

AT a Session of the Academy of Medical Sciences of the USSR, held in Tashkent a few years ago, the following conversation took place between the Indian Professor K. V. Krishnan and the Soviet epidemiologist Professor N. I. Khodukin.

"We in India regard your works on leishmaniasis as classical," Professor Krishnan remarked. "You have been widely quoted also by British and American experts on tropical diseases."

"It is true," said another foreign guest at the session. "Professor Khodukin's works are very well known."

"Now can't you, Professor, conduct your researches at some institute in the capital?" Professor Krishnan asked. "The Moscow laboratories are said to be excellently equipped. Tashkent, after all, is a province......"

"I have had many offers to work in Moscow," Khodukin replied, "but, as you see, I have preferred the province. And I do not regret it."

A railwayman's son, Nikolai Khodukin who took part in the Civil War as a surgeon, was 26 years old, When he first heard about Turkestan, which lay on the southernmost extremity of the young Soviet Republic. This happened in 1921, at an advanced training course for doctors in Moscow when the well-known Professor Martsinovsky, who had travelled extensively in Central Asia, talked at a meeting about this remote, and at that time obscure, part of the country. He was lecturing not on the exotic beauties of this oriental land but on the peculiar diseases wide-spread there: leishmaniasis cutaneous, which left ugly scars on the face, *rishta*, a guineaworm, which affected the inhabitants of the Bokhara oasis, and malaria, which took the toll of tens of thousands of lives every year.

It was as a result of what he learnt that Nikolai Khodukin decided to go to Central Asia. Attracted by the adventure of combating diseases, he felt fully satisfied when he was offered the modest position of the head of an anti-malaria station in the marshy town of Mary (formerly Merv).

The enthusiasm of the head of the anti-malaria station alone was not enough, however, to reduce the flow of patients (who averaged 100 a day). Soon the doctor himself fell a victim to the disease. Thin, tanned by the sun, with stooping shoulders, he spent whole days hunting mosquitoes in the marshes.

Mosquito hunting and night vigils ended only after extensive drainage work had been carried out by the local authorities on Khodukin's initiative and the incidence of the disease had been cut to one-fourth by the joint efforts of the irrigators and doctors. The epidemiologist then left Mary, only to go to an even worse place. This was Mirzachul, a *kishlak* (village) in the Hungary steppe. The epidemic was defeated in Mirzachul too, but the young scientist's own health was undermined. In addition to malaria, he contracted tuberculosis, in a form that threatened his very life.

What were the thoughts of the research worker, who was brought by his scientific passion to the verge of death? Did he curse himself for choosing this God-for-saken place? Did he think of leaving for a healthier place? One of the local scientists showed me a remarkable document, a letter written by Khodukin 30 years ago. Lying in his sick bed in a tuberculosis sanatorium, without any hope of recovery, he jotted down a plan of scientific investigations on a piece of notebook paper, which he urged his friends to carry out by all means. "What I Wanted to Do in Science," is the headline of this letter, which was in fact meant to be the doctor's last will. It contained 14 points representing a complete programme of sanitation work for the region. The main objectives of his plan were to wipe out malaria, to eradicate *kala-azar*, * the "black disease" which affected vast areas in Asia, to discover the virus of sandfly fever, and to find a vaccine against leishmaniasis cutaneus. The letter contained practical advices. Reading these faded lines, one feels that the man, who wrote them, was thinking not of death but of life, that he loved the human race. It was this love, perhaps, that brought him back to life. When Nikolai Khodukin recovered he himself carried out his own behests, from the first to the last point.

* * *

* Phlebatomus papatasii

I have in front of me letters from Brazil and France, India and China, the USA and Israel. Scientists from a number of countries want to know how the Tashkent scientist defeated *kala-azar*, the killer of children. Till recently *kala-azar*, or internal leishmaniasis, was a terror for mothers in Central Asia. The disease, wide-spread among 2 to 3 years old children in Uzbekistan and Turkmenia, led to swelling of the spleen and liver to an enormous extent. The tiny patients acquired a sallow complexion and were doomed, because there was no antidote against this malady. Nor were the sources of the disease and any means of preventing it known.

Khodukin was the first scientist in our country to make a search of the invisible enemy. Together with his assistants, Khodukin investigated tens of thousands of animals. For about twenty years, hundreds of dogs were brought to the institute annually for examination and analysis. To distinguished the carrier mosquitoes from the harmless species, Dr. Khodukin and his assistants covered a vast area, dissected hundreds of thousands of insects and scrutinised them with the microscope.

Kala-azar is fast disappearing in our country. It is disappearing just as *rishta* has vanished in the Bokhara oasis, thanks to the efforts of another enthusiast, Dr. L. M. Isayev, and just as malaria is becoming extinct. (Things have come to such a pass that a persistent request of the Western Ukrainian medical scientists for a little quantity of blood of a malarial patient could not be complied with by Tashkent owing to the absence of fresh cases of malaria in this area). Since diseases, like sandfly fever, sprue or pellagra, have virtually vanished, the tropical clinic of the Tashkent Medical Institute had to be closed down.

The Soviet Government allocated large funds to combat these diseases. The Government sent medical outfit, money and a whole army of scientists and doctors to help those pioneers who, like Dr. Khodukin, began this work on a modest scale.

Naturally, this is a source of joy to the scientist who spared no effort in the fight against disease. But perhaps the time has come for him to relax? Dr. Khodukin enjoys now great prestige as a corresponding member of the Academy of Medical Sciences of the USSR and the Academy of Sciences of Uzbekistan, and he has achieved sufficient public and scientific recognition. In similar circumstances many others would think only of resting on their "accumulated capital."

Professor Khodukin has no such thought in his mind.

* * *

The day was just beginning, yet I was not the first visitor to see him. At his bedside, I found a post-graduate student of the Academy of Sciences, who wanted to consult him on his thesis, and a woman worker of the institute who had come to report on current business. A number of Russian and foreign magazines were strewn on the floor and piled on chairs, a manuscript was lying on the bed. His swollen eyelids testified to a restless night, yet the old man's eyes were smiling. He refused to listen to any talk about his health.

" What were you discussing in the next room? Heroes sacrificing themselves by working in outlying provinces? The favourite topic of visiting journalists! But is this a province? Can you speak of Doctor Zulfia Umidova, who is treating me and whom the greatest Moscow scientists have elected corresponding member of the Academy of Medical Sciences, as a provincial? Or is Professor Sattar Babadjanov, in whose works the Academy of Sciences of the USSR takes keen interest, a provincial? There are thousands of men like them in all spheres of science, industry and art! "

Talking very spiritedly on the way tropical diseases were being combated at present, Professor Khodukin unfolded a coloured map showing the incidence of various maladies in different parts of the world. Though the Soviet Central Asian republics looked extremely small on the map of the world, it was gratifying to see that this region was already free from many colours. Such are the tangible results of the work of one generation of " provincial " scientists! For men like Professor Khodukin, who blot out the colours of disease and death from the map of their country, there is no " province. " They always live at the centre of things.

* * *

When this article had already been written the sad news of the death of Professor Khodukin came from Tashkent. He died as he had lived: a courageous man in love with life and his work. To the last day his assistants and pupils came to his bedside, to the last day he advised his students on their theses and dictated letters.

PROBLEMS OF ALCOHOL

The World and its Bottle

By Prof. E. M. Jellinek
(WHO Consultant on Alcoholism*)

For nearly seven years WHO has been studying the world problems caused by alcohol. This article shows some of the difficulties that have to be faced in the search for recommendations and measures which shall be applicable to all nations concerned.

THE greater part of the literature on alcoholism is of Anglo-Saxon origin. In these nations the steady symptomatic excessive drinkers (with or without addictive features) are so much in the foreground and engage the interest of the student of alcoholism to such a degree that the terms "alcoholic" and "alcoholism" are applied only to these drinkers and the problem is seen entirely in the terms of their drinking—to the complete neglect of other important aspects of the problem.

International experience leads to the conclusion that in many countries problems of national magnitude arise more from other types of drinkers than from the steady excessive symptomatic drinkers.

The latter do, of course, exist in every country where alcoholic drinks are consumed, but they may form such a small group or, even if they reach a fairly large number, the problems arising from them may be overshadowed by the problems presented by other types of drinking.

THE CASE OF FINLAND

In Finland, for example, alcoholic drinks are sold in urban areas only and the violence displayed by Finnish workers when they come to town from some isolated camps and have a few drinks—nothing that could be called a "drinking spree"—causes such damage and is so dramatic that to the Finnish nation this type of drinking and this form of damage constitutes alcoholism.

The steady excessive symptomatic drinkers are by no means absent in Finland (there are probably tens of thousands) and they resemble in their development and behaviour their American, British or Swedish brethren, but their slowly drinking themselves to death seems to present less of a problem than the violence and other damage caused by the occasional explosive relief drinkers.

By the same token, one may suspect that the preponderance of the steady excessive symptomatic drinker in the United States of America may lead students of alcoholism there to underestimate and to ignore the damage arising from *occasional* excess.

Serious damage to society by occasional excessive drinkers occurs in many countries and it may be of small, medium or great frequency. In relation to damage caused by the steady excessive symptomatic drinkers, the occasional excessive drinkers may present an insignificant problem or, on the other hand, their problem may greatly exceed the problem of the former, either through their greater number or the nature of the damage or both.

In Spain, for instance, the group of alcoholics is small, and the group of occasional excessive drinkers with damaging behaviour is considerably larger.

The damage caused by occasional excessive drinkers may be violence (which may occur among steady excessive symptomatic drinkers too, but is by no means characteristic of them), industrial and traffic accidents to which they contribute more than the steady symptomatic drinkers, lowering of disease resistance and absenteeism and over-spending which may represent extensive damage if their number equals or exceeds that of the steady excessive symptomatic drinkers.

WHAT'S IN A WORD

There is a great deal of insistence that the problem of alcoholism varies from country to country. If the term "alcoholism" is extended to occasional excessive drinkers, as is the case in many countries, one may

say with justification that the nature of "alcoholism" shows marked differences throughout the world.

According to the accepted ideas about alcoholism in the Anglo-Saxon countries and even in some Latin countries, occasional excessive drinkers such as weekend or Sunday drinkers, who follow a cultural pattern or "celebrators", and even the explosive occasional relief drinker, would never be regarded as alcoholics.

The extension of the term "alcoholism" to all forms of drinking which may occasion damage is not impossible, as after all any labe of definition is only a matter of convenience and convention and the essential factor is the consistency in connotation. While such a broad connotation would perhaps eliminate much conflict in international communication on this subject, it would hardly be a useful means.

A distinction between what in most Anglo-Saxon countries is called alcoholism, on the one hand, and the serious problems arising out of occasional excessive drinking, on the other hand, is a requirement for clear discussion. Treatment and preventive measures of these various problems cannot be considered relevantly without clear-cut distinctions.

Such public care and treatment as is advocated in the United States of America, England and the Netherlands does not make sense in the case of the weekend drinker who follows a cultural pattern and causes vexatious problems, or in the instance of the occasional explosive relief drinker.

The general use of the term "alcoholism" to cover all these forms of drinking could lead, and has led in some countries, to public-care systems with very variable results, because they apply measures which have been designed with the occasional excessive drinker in mind to the exclusion of the steady excessive symptomatic drinker.

Instead of the extension of the term "alcoholism" to all forms of excessive drinking and the creation of a new terminology to serve the necessary distinctions, it seems preferable to talk about the *problems of alcohol* and to regard "alcoholism" as *one* of these problems.

THE FRENCH VIEW

In France the picture is not one of alcoholism in the sense of symptomatic alcoholism with or without addictive features, nor in the sense of problems created by occasional excess. The French conception of alcoholism agrees, however, with ideas concerning alcoholism in some other prominent wine-producing countries or at least with one type of alcoholism frequently recognized in those countries

There are differences, however, in the conceptions as to its cause, as well as in the description of the behaviour of alcoholics. There is in the French literature on alcoholism frequent mention of *l'alcoolisme sans ivresse* (alcoholism without drunkenness), *i. e.* it is asserted that a drinker can become an alcoholic without ever showing signs of intoxication. This opinion is held by students of alcoholism, as well as by the population at large.

According to an opinion poll, 75% of the men and 82% of the women questioned expressed the opinion that a drinker may become an alcoholic without ever getting drunk. This statement may meet with incredulity in countries where the drinking of distilled spirits is common. Yet, when one observes the French drinking pattern, this contention seems quite plausible.

In the past few years the average *daily* consumption of *pure alcohol* from wine and other alcoholic beverages for adult French males was 130 cc. (4.3 oz.). The average itself is high and it can result only if a fair proportion of the consumers drink considerably more than the average. According to a fairly reliable computation it appears that in 1936 seven per cent of French adult males drank daily amounts of three litres of wine or more (the equivalent of 300 cc. of absolute alcohol and upwards).

While it cannot be said that a given daily amount of alcohol will produce " alcohol addiction ", there can be little doubt that the consumption of amounts from three litres of wine upwards per day, over 15 or 20 years, cannot be handled by the organism without much impairment of metabolic and nervous functions which can be classed as aspects of " chronic alcoholism " even though the ingestion of this amount over 15 hours and the element of adaptation should result in no overt intoxication.

HOW HE DOES IT

A French labourer–particularly in the wine-producing areas—may distribute a total of three litres of wine, beginning with a small glass or two at breakfast. He may drink almost hourly small amounts up to noon when he may take about half a litre with his lunch. This might be followed again by almost hourly drinks up to the evening meal when he might take about a litre, with a few small drinks afterwards.

Under these conditions a drinker of average weight will hardly exceed a concentration of alcohol in the blood of 0.02 per cent. between morning and noon and his highest after the evening meal will be somewhere around 0.12 per cent.

The latter concentration, although fairly high, would not cause visible symptoms in a well-accustomed drinker. On the other hand, the organism of this drinker will hardly ever be entirely free from alcohol, although the blood alcohol concentration will be at levels of " sobriety " during a large part of the day.

The nearly constant presence of alcohol in the organism can hardly be conceived of as not interfering with its normal functioning, and there is a likelihood of acquiring a tolerance which may lead to even larger consumption.

This is not to imply that Frenchmen never get drunk. Intoxication is no rarity in France, but a large proportion of French drinkers may incur some damage characteristic of *chronic alcoholism* without their having ever shown intoxication or any behaviour characteristic of " addictive drinking ".

JUST A " HABIT " ?

Psychiatrists in the predominantly wine-drinking countries, such as France, the Romande of Switzerland, Italy, etc., have frequently seen delirium tremens and other diseases of chronic alcoholism in men who by their past history could not be described as " addictive drinkers " or even steady symptomatic excessive drinkers without addictive features and whose chronic alcoholic complications came to everybody as a surprise. This type of drinker will be tentatively labelled here as the " inveterate drinker ".

With the exception of the younger psychiatrists, French students of alcoholism attribute this type of drinking entirely to social habits and attitudes which are greatly influenced by economic factors.

There is a strong tendency in France and some other wine-growing countries to regard alcoholism as an economic problem. In the view of those countries, save for a few psychiatrists, alcoholism becomes a psychiatric problem only after the excessive drinker develops an alcoholic mental disorder. In the origin of the "habit", however, they see no psychological, not to speak of psychiatric involvements.

Nothing can provoke greater dissent on the part of French physicians and others interested in alcoholism than the contention that pre-alcoholic mal-adjustments lead to the heavy use of alcoholic beverages. Particularly, suggestions as to the pre-alcoholic neurotic character or other marked psychological deviations (let alone the term psychopathy with its different meanings) meet with strong rejection.

This antagonism to the "Anglo-Saxon" ideas as to cause, which is not limited to the French alone, is to some extent quite justified in relation to certain types of steady excessive drinkers in wine-growing countries, but on the other hand the counter-argument cannot be accepted at face value.

The exclusion of psychological factors in the Frenchman's drinking is not borne out by some ideas about the properties of wine in France. In many small restaurants there is on the back of the menu a page with cartoon and slogans, three of which read as follows: "*The wines of France create gaiety*"—"*The wines of France create optimism*"—"*The wines of France give self-assurance*".

This leaflet evidently reflects popular ideas about wine. And if optimism and self-assurance are to be derived from wine, there can hardly be any denial of psychological factors in the Frenchman's drinking.

Again, the accent on creating optimism and self-assurance would indicate that these traits are often deficient in excessive drinkers. This deficiency and its remedy through wine, however, suggests a certain psychological vulnerability, although it hardly could be called an abnormality.

Furthermore, despite the wide acceptance of high alcohol intake in France, only seven per cent. of male users consume three litres of wine or more per day and even users of two litres of wine per day are greatly in the minority.

One may suspect, therefore, a differentiating factor between these heavy drinkers and the majority of wine consumers who drink much less. The "habit" and the social acceptance of heavy drinking are facilitating factors, but cannot account for the entire phenomenon.

In international communication on alcoholism and other forms of excessive drinking, understanding could be reached more easily if psychological *vulnerability* rather than any term suggesting psychological *abnormality* or *subnormality* were used.

Psychological vulnerability has a wide range—from frank neurosis to ill-defined personality weaknesses. In countries such as the United States or Sweden, where there is no social acceptance of heavy alcohol consumption—and, on the part of a round third of the population, there is disapproval of any kind of drinking—by and large the most vulnerable of the population are liable to drink excessively; while in countries where large alcohol intake is generally accepted by society, much less vulnerable persons are exposed to the risk of developing one or the other forms of alcoholism.

That in France a large consumption of wine is generally accepted by the population is evident from the opinion poll referred to above. One of the questions in the survey referred to related to the amount of wine which a man engaged in heavy bodily work may consume daily *without any harm.* The various amounts stated by male interviewees averaged at 1.8 litres of wine, i. e. 180 cc. or 6 ozs. of absolute alcohol per day and amounts of 3 litres and more of wine were acceptable to a fair proportion of interviewees. Female interviewees set the limit for hard-working men 20 per cent lower on the average.

Furthermore, 32 per cent of male interviewees regarded wine as indispensable and 58 per cent as useful in the case of men with great physical activity (only one per cent said that it was harmful).

Another illustration of the French attitude towards wines is that 88 per cent of the men and 72 per cent of the women expressed the opinion that wine is conducive to health.

In many Anglo-Saxon countries one third of the adult population reject the use of alcoholic beverages entirely and the other two thirds do not favour large individual consumption. Under such conditions it may be expected that largely—but by no means exclusively—persons with a high degree of psychological vulnerability will be exposed to the risk of alcoholism.

IN ITALY, CONTEMPT

On the other hand, in countries which have a high degree of acceptance of large alcohol intake—such as France—a small degree of vulnerability may trigger off alcoholism.

There are other factors which influence the ideas about the nature and origin of alcoholism. In Italy, although the "inveterate drinkers" may be smaller in number than symptomatic alcoholics with or without addictive features, a drinker is classed as an alcoholic largely when he develops one of the alcoholic mental disorders.

In the absence of such a disorder the excessive drinker is just a "drunk" and this is largely due to the fact the Italian has a great contempt for the drinker who discredits the use of wine, which he regards as one of the traditional fine products of the country.

Swiss students of alcoholism recognize a certain proportion of pre-alcoholic neuroticism and "psycho-pathology", but maintain that the majority of alcoholics in Switzerland are "primitive hedonists" who get intoxicated or near intoxicated for the sake of mere pleasure and, in continuing this practice, eventually become "chronic alcoholics".

On acquaintance with this "primitive hedonist" one finds a person with an extremely narrow field of interests, practically an inability to take interest in anything else but himself and a narrow circle around him. There is also generally an inability to respond adequately to the finer stimuli of life. This narrowness of interests constitutes a psychological vulnerability which is the source of the "mere habit" of heavy drinking.

All the ideas about alcoholism in a given country have a good deal of truth in them but they become modified in the light of experience from other countries.

The "inverate drinker" who predominates in France may be found in every country where alcoholism exists, but in countries where the symptomatic and addictive alcoholics predominate the

ideas derived from them as to origin and behaviour are extended to all other heavy drinkers.

ALCOHOL AND ECONOMICS

The "economic origin" of alcoholism is an idea that is frequently expounded in European countries and some of the South American wine-growing countries. This economic outlook is in gross contrast to the psychiatric theories current in the Anglo-Saxon countries, but it cannot be overlooked without detriment to a clear understanding of the problems of alcohol.

By "economic origin" is meant first of all the vested interest in the production and sale of alcoholic beverages which in some viticultural countries is of extraordinary intensity.

But the economic insecurity of the individual and poor housing conditions (rather common in France), which induce the dwellers to look for a more pleasant environment in the taverns, may also be designated as economic factors of habitual heavy drinking. In the latter instances, too, some psychological vulnerability of the individual must be assumed, as only a minority of the persons suffering from these conditions succumb to excessive drinking. Such vulnerability may be less resistance to these adversities and few resources to cope with them.

When the French speak of the "economic origin" of alcoholism, they mean that the viticultural interests and the industrial and trade interest related to the former are the decisive factors in the genesis of alcoholism.

In France viticulture constitutes a highly important part of the country's agricultural wealth and millions of its inhabitants earn their living through the production of the raw materials, and the processing and sale of alcoholic drinks. The interests of these groups do contribute toward a general acceptance of large consumption. There exists an identification of the general population with these interests, which are recognized as national ones.

COMPARISONS

These interests dominate public opinion through a variety of propaganda and reinforce customs which make drinking an obligation. Furthermore the enormous wine production demands a large number of outlets. In France there is about one wine outlet for each 97 inhabitants. The ubiquitousness of alcoholic beverages leads to greater consumption, and the number of alcoholics increases as the number of consumers and the amount consumed increases.

In Italy the area under viticulture represents 10 per cent of the arable land and is somewhat larger than in France, and 10 per cent of the "active population" earn their living entirely or in part through the production and sale of wine. Nevertheless, France exceeds the Italian alcoholism rate at least five times.

In spite of all economic interests the number of inhabitants per outlet in Italy is about two and a half times as great as in France (and is progressively being restricted towards a limit of 400 inhabitants per outlet) and the consumption of total absolute alcohol per head is half that of the French.

Also the pattern of drinking in Italy differs greatly from the French pattern (drinking is restricted practically entirely to meals) and distilled spirits play an insignificant role, while in France, where distilled spirits contribute 14 per cent towards the total alcohol consumption, this latter type of beverage nevertheless has a larger consumption-rate per head than in countries where it is the predominant source of alcohol (e. g. Finland, Sweden, Norway).

These facts indicate that the economic interests alone cannot account for the extremely high alcoholism rate in France, but there must be some differentiating factors between France and other large wine-growing countries with marked vested interests. These differentiating factors must be in the nature of cultural patterns as well as collective and individual psychological elements.

THE TRUE PROBLEM

Nevertheless, the economic factors are of great importance. The true economic problem in France in relation to alcoholism is that, because of pressures of vested interests, it is extremely difficult to establish legal and educational controls and even to launch a nation-wide campaign for the public care of alcoholics. The slightest mention of anything of this nature provokes vigorous antagonism not only on the part of the vested interests, but also on the part of the majority of the population.

It is of great practical importance to show the economic and social factors in their proper perspective.

If public-health authorities are led to believe that the problems of alcohol are entirely economic and social problems, they will not see the cogency of incorporating the control of alcoholism and the rehabilitation of alcoholics into their programme of activities.

On the other hand, if it can be shown that socio-economic factors are a contributing element in causing the problems of alcohol they will not shy away from it, as such factors are to some extent elements of most or all health problems with which they have to cope.

Improvement of the economic factors is, of course, not within the sphere of the public health authorities, but they can show other competent authorities how these factors interfere with the control of the health problem and engage their co-operation.

As said before, the economic factors of the problem require a good deal more than just the mention that they exist—and that is usually as far as Anglo-Saxon scientific students of the problem of alcohol will go—but on the other hand the singling out of the economic component—as is largely the case in France and Chile—tends to obscure the issue.

We may add that in Sweden, where the economic pressure does not seem to exist—as the Government monopoly is devised to eliminate the element of profit—the problems of alcohol are much greater than in Spain or Italy with their great economic stake in viticulture.

To sum up, it may be said that all types of "alcoholism" and all types of damage through occasional excessive drinking exist in all countries where alcoholic beverages are consumed.

In the final analysis there is a common factor in all manifestations of the problem of alcohol and that is a certain psychological vulnerability. This is true even of occasional excessive drinking.

* Extracts from a paper presented to a Joint Meeting (1954) of the WHO Expert Committees on Mental Health and on Alcohol.

INFANT CARE WHILE TRAVELLING

By Dr. U. Sripathi Rau, M.B., B.S.

TRAVELLING by rail is the most popular mode of travel in India. For the middle and the lower classes of people it is a boon. Even the old who are wrinkled and the new born who are fresh and chubby are carried from place to place by rail in comfort. The bringing up of the young infant requires a lot of care and patience and mothers are remarkably well suited for such work. The care of the baby while travelling requires considerable preparation and patience. By proper care, the infant can be well fed and its chances of being infected can be reduced to a minimum during travel. The risk of accidents to the infant can also be reduced. In this short article on " Infant care while travelling " I have given a few suggestions which I hope will be useful to the travelling public, especially mothers including those who belong to the families of the railway workers.

CARRYING THE BABY IN A BASKET

The usual method of carrying a baby is in the mother's arm. When the baby is inclined to sleep it is placed on an improvised bed of a few clothes on the seat. The better method, as followed by some mothers in Europe and America is to use a small light basket, 2 ft. in length, 1½ ft. in breadth with sides of 6 inches height.

The size of the basket can be varied according to the size of the baby. The advantage of such a basket are many but the important ones are :

(1) Easy to carry without disturbance to the infant.

(2) Can be placed in comfort on the seat or any convenient place, as it is, without any preliminary preparation of a bed.

(3) It prevents the child from rolling off the seat. This is the most important advantage.

CLOTHING

Warm clothing should be used in the cold season and light garment during summer. Woollen garments should not come in contact with the skin as they may produce eruption or rash on the soft delicate skin of the infant. During journeys, especially during hot summer days, dusting of the child's body with some talcum powder would bring comfort to the infant. Ears may be plugged with cotton wool so as to prevent the child from being frightened by the whistling and roar of the engines. The shutter near the child's seat should be closed to prevent the coal dust from getting in.

FEEDING

Feeding of infants during long journeys is a problem for most mothers. They feed the child with whatever they get on the way. Such food is often found to produce digestive disorders even before the journey ends. The giving of coffee is to be discouraged, for coffee is not only not nutritious but also harmful for small children.

If the child is on breast milk, it must be fed once in 3 or 4 hours, 5 to 6 feeds a day. One feed may be given at night at about 2 A. M. if the child needs it during the journey. The difficulty is felt only when the child is on artificial milk like cow's milk or tinned milk powders. In such cases undiluted cow's milk, well boiled should be taken in thermosflasks. When the child is to be fed, equal parts of hot water (available in refreshment rooms) and the pure undiluted cow's milk from the thermos added and the diluted milk mixture given to the infant. The sugar is added to this milk at the rate of 1 teaspoonful to every 3 ounces of the diluted milk, which is then suitable to the infant's digestion.

Milk powders keep sterile for a long time and can be used for infants in comfort and ease while travelling. Hot water is available in all refreshment rooms and dining cars where such cars happen to be attached to the trains. My suggestion to the authorities is to make arrangements for the availability of good, well boiled cow's milk, especially for the feeding of infants, at least in big stations.

Condensed milk can also be used and the sweetened variety is preferable for it has not only the quality of keeping for a long time even outside the refrigerator, when once opened, but also has a high calorific (energy) value. It must not, however, be given persistently over a long period for it might produce Rickets and Scurvy and also fermentation or wind in the Intestines or belly. During journeys it can safely be used.

Good biscuits and rusks can be carried on a journey and given to children. Orange juice taken from fresh oranges available on the platform can be given even to the smallest infant with benefit with a little water and sugar added. It contains one of the essential vitamins—Vitamin C.

For older children, prepared home-made foods are preferable and can safely be taken in tiffin carriers or baskets. In short give the best food to the growing children and adults will take care of themselves.

TOYS

Suitable toys can be taken while travelling, to comfort the infant. The toys must be cleaned before giving it when once it has fallen on the floor of the compartment.

CLEANLINESS

'Cleanliness is next to Godliness' and 'A healthy mind in a healthy body', are the two sayings which are very apt. Cleanliness must be strictly followed while travelling to prevent the spread of infection and disease especially where there are small children in the compartment. Spitting and blowing of the nose and spreading the nasal secretions on the seats and the sides should be strictly avoided to prevent the spread of infection. Think of the safety of other children as you would think of your own. The sweepers of the Railways are willing to co-operate with the passengers in keeping the compartments clean and tidy and their services can be utilized. Napkins should be used to dispose of the child's excreta. Torn cloth can be safely used and then thrown into the latrine wash-out sink. Throwing out of the window should be avoided as the thing thrown might splash into the rear compartments.

The child's feeding utensils and feeding bottles should be washed in good water. In this connection I would request the railway authorities to provide running water with a wash basin in all III class compartments particularly in women's compartments.

SICK CHILD

Extra care should be taken while travelling with a sick infant. Doctor's advice is to be sought before undertaking such a journey.

Special problems of infants require special precautions and care and the family doctor is the best suited for giving such an advice.

Better Health through Better Milk

Health is a prerequisite for hard work such as is being put in Railway Workshops. In ensuring good health good milk is essential and here the advantages of dried milk in the tropics are discussed.

SPEAKING at a meeting of the Royal Society of Medicine in England as long ago as 1937, Dr. W. G. Savage reminded his hearers that way back in 1857 an outbreak of typhoid fever had been traced to milk.

"..........Nowadays the significance of milk as a vehicle of infection is obvious, since there are three contributory factors: the liability of the cow to diseases transmissible to man; the suitability of milk as a culture medium; and the large amount of handling between cow and consumer which enables human disease to be conveyed by milk.

"The important diseases spread by human infection of milk are diphtheria, scarlet fever, typhoid fever, para-typhoid fever, dysentery and occasionally angina ....There is overwhelming evidence that milk is an important source of disease. Elimination of the use of raw milk would go far to prevent milk-borne disease."

OTHER SIDE OF THE PICTURE

The foregoing is almost enough to stop most of us from ever drinking milk again, but we must look at the other side of the picture.

Milk is a perfect food; it contains all the necessary elements for proper growth and development and for the maintenance of health. Carbohydrates, fats, proteins, mineral salts, vitamins and water—all of these it includes in the correct proportions and most desirable forms. Therefore, pure fresh milk is the most valuable food—it could almost be called a complete food, but the objection to living on a diet consisting wholly of milk is the large amount that would be required. This does not apply in infancy; in fact in infancy milk is indispensable. Milk also plays a conspicuous part in the diet of growing children and convalescents. It is therefore easy to understand that for Milk to do its good work, it must be pure, and free from all harmful substances.

In the tropics the word "Milk" does not necessarily mean cow's milk, but is applied to the mammary secretions of various animals, each having differences in composition. Moreover it is likely to have been produced under the most primitive conditions, handled by people ignorant of hygiene, and to have been held for long periods at a temperature conducive to bacterial development.

Unfortunately for us adulteration of food products is practised in India by a section of unscrupulous traders, and milk is no exception. Any day the cameras of vigilant staff-reporters of Indian newspapers could catch 'goalas' or milk-traders adulterating milk with hydrant, drain or pool water thereby polluting it, probably with various types of bacteria. No doubt, by purchasing this sort of milk, consumers buy diseases.

Where, then, is the safeguard? The following opinion of two specialists makes it clear that scientifically prepared dried milk will serve the purpose best.

Extract from "Modern Methods of Feeding in infancy and Childhood" by Donald Paterson, B. A., M. D., F. R. C. P., and J. Forest Smith, F. R. C. P.

"The chief advantage of a dried milk lies in the fact that it is a sterile preparation whose composition does not vary. Some of the dried milk is obtained from cattle which are pasture-fed the whole year round and so give a less variable composition than "stall-fed" milk.

When travelling or when living in the tropics, dried milk possesses obvious advantages over ordinary milk, and it is easy to obtain, to keep and to make up as feeds."

VITAMIN CONTENT UNIMPAIRED

There are many advantages in the use of dried milk over the fresh variety. Packet in a sealed tin, powdered milk is sterile, and is certainly to be preferred to contaminated fresh milk. The percentage of ingredients is known within reasonable limits. The nutritive value seems to be uninjured; indeed, it is probably improved, both because of the alteration in the proteins, the casein being divided into minute particles during the process, and because the size of the fat globules is reduced

during manufacture. The keeping qualities also are excellent. It is claimed that none of the vitamins (A, B, C or D) is impaired in the process.

Thus good dried milk has definite advantages over doubtful fresh milk. The main virtues in its favour are : constancy of composition, sterility, digestibility, keeping qualities and ease in preparation.

In countries, districts or cities where fresh cow's milk is not readily available or of doubtful quality, the concentrated milks from reliable manufacturers are the only really safe forms of milk supply, and there is no better or more convenient form of milk than the powdered one.

The Nestle Company, leaders in milk research for over 80 years, have made it their business to find the perfect answer for milk problems, and as the result of such painstaking care and attention to details Nestle's have produced a pure milk under the name of " Nespray." Nespray Powdered Milk is pure full-cream powdered milk from which the water has been removed leaving the milk solids in a powder form in the same proportion as in fresh milk. It contains no preservative or added substances. The fresh milk is subjected to careful laboratory examinations to ensure its suitability, physically and bacteriologically, for all purposes where milk is used. Before dehydration, the milk is pasteurized; desiccation is then carried out by a special spray process, which retains the essential vitamins and ensures an excellent keeping quality for a considerable period.

It can therefore be understood that milk is a definite " must " in everybody's life from birth to old age, but it must be pure milk, and in this country no better answer can be provided than Nespray Full-cream Powdered Milk, which has behind it the benefit of the Nestle Company's years of extensive research and experience.

Nespray Full-Cream Powdered Milk is therefore the ideal substitute for fresh milk, especially in the tropics ; it is indeed the safe milk for all purposes.

A RARE OPERATION ON HEART

A rare operation was done last October at the Institute of Chest Surgery of the Academy of Medical Sciences of the USSR, headed by Prof. A. Bakulev.

A man who has previously worked as foreman at a plant came with a heart-complaint. The examination showed that, as a consequence of rheumatism, he had developed a double heart disease : the narrowing of the passage between the left auricle and the left ventricle and the narrowing of the aperture through which the blood passes from the ventricle into the aorta. Thus, the blood enriched with oxygen in the lungs not only had a difficulty in getting to the heart's left ventricle, but was also hampered in its ejection from the ventricle during its contraction. The patient was unable to work, and his condition was deteriorating.

Under these conditions the operation of broadening only one passage, the one for letting the blood into the ventricle, would be of no use, while the simultaneous broadening of two passages had never been tackled in the Soviet Union before.

After a careful examination Prof. S. Kolesnikov, D. Sc., did the double operation. He expanded the inlet and immediately after it, the outlet. The operation proved successful. The patient is recuperating, feels much better and thinks of resuming his work.

*** *** ***

A LESSON

" Hallo Gopalan ! Jai Hind, How do you do ?"

" Quite well myself, thank you, but what may I state about the difficulties in which I am about sickness at home. Firstly my son was down with typhoid for about six weeks ; then my daughter for about the same period and it is now the younger child suffering from it. I don't know what I had done to deserve such a punishment at the Almighty's hands. For the past four months I am passing sleepless nights at home and during the day I have to go on duty as you know I can ill afford to have long periods of leave at a stretch".

" But don't you know that Typhoid is a more or less contagious disease which spreads from the stools etc. of the patient and once in a family it goes out by some effort. I had suffered in a similar manner sometime ago but thanks to the doctor who advised me to have all the other inmates of my house inoculated against typhoid. I got that done at the Railway Hospital absolutely free of charge and was then out of trouble. It is meant for you and you alone the Railway servants. I am getting my children this injection every year before the summer sets in. Why don't you avail of the free facility ? "

" I'll now do that. Thanks. Jai Hind."

BOTTLE FEEDING

IT very often happens that for some cause such as deficiency in the quality or quantity of the milk a mother is unable to feed her baby. Then a decision has to be made—one that is of vital importance to baby's future health and happiness—what substitute food is to be used?

It will of course be cow's Milk in some form but ordinary cow's milk is not suitable for babies as the composition is quite different from human milk and the curds formed in the stomach are tough and leathery, not easily digested by the very young. Cow's milk can be modified in the home by various additions and dilutions, which must be made with great care but even then one cannot be certain of the purity of the milk.

LACTOGEN

If, then, you cannot breast feed baby, give him LACTOGEN. Babies thrive on it; they grow sturdy, strong, vigorous, healthy and happy. LACTOGEN is prepared from pure, full-cream milk and modified especially for infant feeding. The fat globules are broken up and are even smaller and more easily digested than those of human milk. The process is entirely mechanical from milking to packing into airtight tins and LACTOGEN is untouched by hand until you open the tin. Being in powder form LACTOGEN will keep good for an indefinite period—there is no question of sour milk as only the exact quantity need be prepared for each feed.

FEEDING TABLE FOR INFANTS

The mixtures given in the table give good results in most cases but may be changed if the doctor so advises. Opinion differs as to the intervals between feeds but if four-hourly feeding is commenced earlier than six months the quantity of each feed must be carefully calculated. Multiply the quantities given in the table by six and give a fifth at each feed.

Quantities for each feed.

Age of Child	Lactogen Level Table-spoons*	Boiled water Table-spoons*	or fluid ozs.	Number of feeds per day.
1st week	¾	4	2	6
2nd & 3rd weeks	1¼	6	3	6
4th week	1½	7	3½	6
5th to 8th weeks	2	8	4	5
9th to 10th weeks	2½	9	4½	5
11th to 13th weeks	2¾	10	5	5
4th month	3	11	5½	5
5th month	3¼	12½	6¼	5
6th month	4	14	7	5†
7th month	4½	15	7½	5†
8th to 12th months	4½	16½	8¼	5†

*The tablespoons referred to are medicinal measures which never vary as do household spoons. A medicinal tablespoon contains, when filled level, ¼ oz. of Lactogen or ½ oz. water. (1 tablespoon = 4 teaspoons.) It is a wise plan to keep one spoon aside for measuring baby's food so that the strength may never vary.

† As supplementary foods are introduced into baby's diet the bottle feeds should be correspondingly reduced.

After 8 months, continue to give five feeds daily in the proportion of 4½ tablespoons LACTOGEN to 17 tablespoons (8½ fl. ozs.) water, but increase gradually the quantity to as much as the child can easily digest.

IMPORTANT

When commencing to feed baby with LACTOGEN, mix only half the quantity of LACTOGEN with all the water for the first feeds, then gradually increase the LACTOGEN to the quantity indicated.

The same procedure should be followed for a longer period with babies below normal weight or those suffering from digestive troubles. LACTOGEN should agree with all babies, and in cases where it does not, the trouble is practically always due to overfeeding

PREPARING THE FEED

Measure into a deep receptacle the indicated amount of warm (previously boiled) water. Sprinkle on top the required quantity of *LACTOGEN* and stir briskly with a fork until completely dissolved. Pour at once into a feeding bottle and give to baby at normal blood heat (98°F.). If a food thermometer is not available, test the heat by shaking a little of the mixture on to the back of the hand where the skin is sensitive.

FEEDING BOTTLES

The bottles should be those that may easily be kept clean. Those with openings at both ends are preferable. The Nestle's Feeder has been especially designed so that water may be poured through from end to end and it is fitted with rubber teat and valve to regulate the flow. Unfortunately these are not always available owing to difficulties of supply. Whatever bottles you use make certain that they are scrupulously clean. Wash out after each feed and sterilize each day by boiling. Keep them submerged in the water in which they are boiled and keep the receptacle covered. Remember to keep spares in case of breakage.

CARE OF TEATS

The proper care of teats not only ensures cleanliness but also prolongs their lives. They should be rubbed inside and out with common salt to remove the milk slime and finally rinsed in boiled water. Keep them on a clean, dry saucer under a cup.

OPENING OF TAKAL-AMULLA SECTION ON THE KHANDWA-HINGOLI METRE GAUGE RAIL LINK

A further section of 15 miles from Takal to Amulla, on the Metre Gauge rail link between Khandwa and Hingoli was opened for all kinds of traffic on April 15th, 1958. The opening ceremony was performed at Amulla station by Shri E. G. Kotiswaran, Divisional Superintendent, Central Railway, Bhusaval. This new line in the Nimar district connects Khandwa with villages Mordarh, Takal, Gurhi, Amulla and Tukaitad.

The opening ceremony was performed in the presence of a large number of railway labour, staff, district officers and general public. A Community Dinner was arranged for the workmen on the construction project by the Officers and staff of Khandwa Construction division. This was followed by a variety entertainment consisting of some items of folk dance performed by the tribal people, Korkus and Banjaras. The Deputy Chief Engineer, Shri D. G. Divgi, gave "On the Spot" awards to five of the distinguished workmen of the construction division who helped the construction of this 15-mile length of track within a record time of 10 months.

The function was attended among others by the Collector of Nimar, Shri S. S. Gill, the District Judge, Shri S. N. Mishra and the District Superintendent of Police, Shri P. C. Pandey.

* * *

CONCESSIONAL RETURN TICKETS TO SRINAGAR

From 1st April, 1958 and upto 31st October, 1958, First, Second and Third class rail-cum-road and rail-cum-air return tickets at the usual concessional rates are being issued to Srinagar via Pathankot from Bombay V. T., Byculla, Dadar, Poona, Nagpur, Jubbulpore, Agra Cantt., Raja-ki-Mandi, Agra Fort, Agra City, Secunderabad, Begumpet, Kurnool Town, Hyderabad Town, Kacheguda, Gwalior, Bhopal, Sholapur and Saugor stations on this Railway, in accordance with the rules in force.

These concessional return tickets are valid for three months for completion of the return journey from the midnight of the date of the commencement of the outward journey. Intending passengers are, however, required to make their own arrangements for securing the permit from the District Magistrate or the authority concerned for entry into Kashmir.

PREVENTION OF TYPHOID FEVER

By P. V. Kurian, M.B., B S., D.T.M., M.S., (Michigan)

Is typhoid fever a serious public health problem in the Madras State?

AS in many other parts of India, typhoid fever is definitely a serious public health problem in this State. It is also important as a yardstick for the sanitary standard of a community. The following figures from the "Report on the Health Conditions in the Madras State" for the years 1949—1952, bear ample evidence to this.

Number of cases of enteric fever treated in State Hospitals in Madras.

Year	Cases treated	Deaths
1947	25,681	757
1948	28,521	739
1949	31,809	943
1950	65,694	1,499
1951	48,796	1,427
1952	54,983	1,426

The cases treated by private practitioners and quacks are not included in this table. The tremendous economic waste can be imagined if we calculate the cost of treatment per patient at Rs. 100. Due to the wider use of chloramphenicol number of deaths from typhoid have been reduced; but the incidence both in towns and rural areas shows no evidence of subsiding.

What are the sources of infection?

Faecal and urinary carriers of typhoid bacilli are reputed to be the sources of infection. Bacilli excreted by the carrier, find their way through food or drink, to susceptible individuals, setting up infection in them. The story of "Typhoid Mary" is a classical example. For years, in the Army in India, much effort was directed to the detection of typhoid carriers. In the School of Tropical Medicine at Calcutta, where faecal samples of all inpatients are

cultured as a routine, an occasional carrier of typhoid bacillus is detected. During World War II, an increased incidence of typhoid among British soldiers in Egypt, was traced to increased number of urinary carriers among the Egyptian food handlers serving them. In 1946, in U. K., 146 cases of typhoid fever were traced to one urinary carrier who manufactured and sold ice-cream. A few years ago, one urinary carrier of B. paratyphosus A was detected in the course of routine work of this Institute. In countries where typhoid is rare, it is possible to trace epidemics to the source by certain laboratory methods like "Sewer Swab" technique of isolating bacilli and phage typing of isolated organisms

If carriers are detected, can they be treated and cured of the carrier state?

Many carriers never had an attack of typhoid. Treatment of the carrier state has been very disappointing. Chloramphenicol, which is very useful in the treatment of the disease, is useless for the treatment of carriers.

What are the common vehicles of infection?

Articles of food and drink which convey the infection can be divided into those in which the organisms do multiply and those in which the organisms do not multiply. In milk and milk products the organisms do multiply. In water typhoid bacilli do not usually multiply. The bacilli are easily killed by boiling and adequate chlorination. Fly infested fruits and vegetables eaten raw, can convey the infection. In Australia many cases of typhoid were traced to dessicated cocoanut prepared in New Guniea, and used in pastries without heat treatment. The companies manufacturing this product withdrew all supplies from the market when it was proved that it was responsible for this epidemic. Coutneys made from cocoanut, raw vegetables etc., and not submitted to heating can also transmit the infection. Waterborne epidemics are rare, even though some epidemics like the Croydon epidemic of 1939 have been traced to contaminated water supply.

What personal measures can be taken to prevent typhoid fever?

Boiling of drinking water, especially in rural areas where a protected water supply is not available, is an important step. The common parasitic ailments and virus diseases like infectious jaundice and poliomyelitis can be prevented by this one step. Equally important is the safe disposal of human excreta. This is the hardest task, but the most rewarding too. This can be achieved only if all people realise the risk of indiscriminate defecation. Children seem to be the greatest offenders. Consequently they carry the maximum load of worms.

The role of the home and the school in the training of children in correct health habits cannot be overestimated. For instance, the thorough washing of the hands with soap and water after defecation, should be taught to every child both at home and in the school.

In the control of typhoid fever, what communal measures are likely to be effective?

In a country which is mainly agricultural and rural, environmental hygiene depends on the level of knowledge of the individual. All methods of mass contact should be utilised for education of the people.

Hygiene of restaurants, feasts and festivals is also very important. The organisms excreted by a carrier, (who may not be a danger in an isolated village) are widely disseminated during feasts and festivals. The Public Health staff should approach the restaurant managers with constructive suggestion about the storing and handling of cooked food, washing of dishes, control of flies and other insects and the provision of washing facilities.

What is the place of T. A. B. vaccine in the control of typhoid?

Till such time as our hygienic standards are improved this appears to be the only reliable measure. The efficacy of T. A. B. vaccine has been adequately proved, even though wide field trials with adequate controls have not been undertaken. The quality of vaccine is important. During the Second World War, Italian prisoners of war who were protected by Italian vaccine had high incidence of typhoid when the Allied soldiers living in the same environment were free from typhoid.

It is advisable to protect school children in highly endemic areas, like some of the villages in Nilgiris, every other year. In this District, patients below 15 years formed more than half the patients admitted to hospital for typhoid. The Army has found ½ cc. of T. A. B. vaccine given every year to soldiers to confer adequate immunity.

With the cooperation of private medical practitioners, hospitals, laboratory workers and public health staff it should be possible for us to eradicate typhoid in about ten years from now.

RAILWAY WEEK ON THE CENTRAL RAILWAY

THE Railway Week was celebrated over the Central Railway from 10th to 16th April 1958, the latter date being the 105th Anniversary of the running of the first train in India which steamed out of Bombay. Opportunity was taken to focus public attention on problems and achievements of the Railways. Banners bearing slogans, inviting co-operation of Railway users in tackling problems like ticketless travel, pulling of alarm chains, hawker and beggar nuisance were displayed at important stations.

During the Week, special drives were undertaken which emphasised punctuality of trains, cleanliness of station premises and coaches, courtesy towards public and integrity in public dealing. In this five pronged drive, an endeavour was made to set before all Railwaymen, the highest standards of service to Railway users. An intensive educative publicity campaign in respect of these drives for the staff in the workshops, loco-sheds and at a number of stations were put into effect during the Railway Week.

Social education films and film documentaries intended to train people in the proper use of the amenities provided by the Railway were exhibited to passengers at a number of railway stations.

Opportunity was also taken to declare open several new projects and constructions. On the Khandwa-Hingoli project linking the Southern and Northern Metre Gauge systems, a further section of 15 miles between Takal and Amulla was opened for traffic during this Week.

At functions held during the Week at the Headquarters and Divisional Offices over the Railway, prizes were distributed and merit certificates awarded for good work done by different sections of the staff.

Cultural programmes were also arranged all over the Railway to give an opportunity to the staff to exhibit their talents. This included music, dramatics, variety entertainment etc.

GOLDEN RULES OF CONDUCT FOR RAILWAYMEN

1. Do you plan your work daily? Get the more essential things done first and do not neglect the important ones sidetracting them to the fag end of the day.

2. Do not express casually careless opinion. Never venture forth an opinion unless asked for it.

3. Remember that most of our mental worries come either from trying to fight life hard or from trying to run away from life. Do neither.

4. Learn to accept people as they are, love them, respect them, praise them, encourage them, differ with them, but above all, learn the priceless art of give and take.

5. Cry neither for the moon, nor over spilt milk.

6. Accept the things that you cannot change; have the courage to change the things that you can, and possess the wisdom to know the difference.

7. Do not drive too hard a bargain with yourself.

8. Accept life as it is—its wonders, changes, disappointments, frustrations etc., etc.

Fuel and Power Industries in the United Kingdom

THE main primary sources of energy in Britain are coal, petroleum and, to a small extent, water power; secondary sources, produced from these, are electricity and coal gas.

Coal, mined within the country, supplies 86 per cent of Britain's energy and it must continue to be the main source for many years to come. But it is unlikely that production of coal can be increased sufficiently, even by the very large investments planned, to satisfy increasing demands for energy, which may well double within the next twenty years. For supplies of crude petroleum Britain is almost entirely dependent on overseas imports; water power resources are limited. For these reasons, Britain is investing large sums in the development of nuclear power as an alternative source of energy. But the new source will not start bearing much of the burden for at least ten years, after which time its use should increase rapidly. The fuel and power industries, with the exception of the petroleum industry and coal distribution, are mainly under public ownership.

The Government's fuel and power policy has two principal objectives. The first is to ensure that power supplies are adequate to meet the rapidly growing demands of industry and of the domestic consumer in a country with an expanding national income. The second is to make the maximum possible use of indigenous resources and so lighten the load on the balance of payments.

The Government also aims to reduce air pollution. The Clean Air Act, 1956, makes it an offence to emit dark smoke or to fail to provide industrial premises with equipment to arrest grit and dirt, and empowers local authorities, subject to the approval of the Minister of Housing and Local Government, to declare 'smoke control areas', in which the emission of smoke from chimneys will constitute an offence; provision is made for the payment of grants by local authorities and the Exchequer towards the costs incurred by owners and occupiers of houses in these areas in making necessary changes to appliances. A Clean Air Council, to review progress and to advise the Minister, was set up in May 1957.

COAL

Coal has been worked in Britain for over 700 years and an organised coal-mining industry has been in existence for over 300 years, some 220 years longer than in any other European country. British coal exports dominated the world coal market until about 1910. By 1913—the peak production year—the industry was producing 287 million tons of coal, exporting 94 million tons and employing 1,107,000 workers.

The very fact that the British coal-mining industry was developed so early has meant that many of the best seams of coal are now worked out; every year coal has to be mined from deeper and thinner seams and productivity can be maintained only by increasing efficiency.

The industry declined during the first world war owing to a shortage of man-power and to the shortage of plant and materials necessary for undertaking any mechanical improvement. Moreover, alternative sources of energy and lower prices in continental countries led to a later decline in exports, which had fallen to 67 million tons in 1925.

Attempts at securing economies through amalgamation date from the Sankey Commission of 1919. In 1930, a Coal Mines Act established commissioners to bring about the formation of larger and more efficient units. The Coal Act of 1938 transferred ownership of the mineral coal to the State and made it the statutory responsibility of a Coal Commission to accelerate the integration of the industry by still further reducing the number of separate undertakings. At the outbreak of the second world war in 1939, however, this process was not far advanced.

ORGANISATION UNDER PUBLIC OWNERSHIP

In 1942, the Government assumed full control of the industry's operations, though the colliery undertakings continued to own the coal-mines. In May 1946, the Coal Industry Nationalisation Act received the Royal Assent. On 1st January, 1947, the assets of the industry were vested in the *National*

Coal Board, which was appointed by the then Minister of Fuel and Power and became responsible for the industry's management. Under the Act, the Board consisted of a chairman and eight other members, but this provision was amended by the Coal Industry Act, 1949, and the Board now consists of a chairman and not fewer than eight or more than 11 other members; the number of full-time members must not exceed eight and there must be one, and may be two, deputy chairmen.

The Board's main duties are:

(1) to work and get the coal in Great Britain to the exclusion of any other person;

(2) to secure the efficient development of the coal-mining industry; and

(3) to make supplies of coal available of such qualities and sizes and in such quantities and at such prices as may seem to it best calculated to further the public interest.

The Board is also charged with securing the safety, health and welfare of its employees and the benefit of their practical knowledge and experience. The Board's policies must also be directed to ensure that its revenues shall be not less than its outgoings properly chargeable to revenue account and taking one year with another.

There are minor exceptions to the Board's exclusive monopoly to work coal in Britain: for example, it may license private enterprise to work small mines in which the number of underground workers does not greatly exceed 30. Production on opencast sites, which had been the responsibility of the Ministry of Fuel and Power (as it was then called), was transferred to the Board on 1st April, 1952.

The Board is responsible for its own regional organisation. The collieries, numbering about 900, are grouped into 50 Areas which are the basic units for commercial management. The size of the Areas varies according to geological, geographical and other technical considerations. The Areas are grouped into nine Divisions which roughly correspond to the main coal-bearing regions. A Divisional Board for each Division supervises and co-ordinates the work of the Areas within the Division (except in the small South Eastern Division, which is administered by a General Manager), formulates divisional policy, and is answerable to the National Coal Board, which is responsible for questions of national policy, finance and the co-ordinating of major schemes of development. The day-to-day work of running the collieries is under the direction of colliery managers.

Two Coal Consumers' Councils were set up under the 1946 Act: the *Industrial Coal Consumers' Council*, members of which represent consumers, merchants and suppliers of coal, coke and manufactured fuel for industrial and other purposes, involving supply in bulk; and the *Domestic Coal Consumers' Council*, members of which represent similar groups concerned with coal for domestic use. The most important function of the Councils, which are responsible to the Minister of Power, is the general consideration of the commercial arrangements and activities of the National Coal Board, to ensure that the monopoly in the industry set up by the 1946 Act shall have the maximum practical regard for consumers' interests.

The Coal Industry Nationalisation Act requires the National Coal Board to publish an annual report and statement of accounts which are laid before Parliament.

At the end of 1947 (its first year), the National Coal Board showed a deficit of £ 23.3 million, after paying compensation to the former mine-owners and interest on borrowed capital. In the years 1948, 1949 and 1950 there were surpluses of £ 1.7 million, £ 9.5 million and £ 8.3 million respectively. There were deficits of £ 1.8 million and £ 8.2 million in 1951 and 1952, a surplus of £ 0.4 million in 1953, deficits of £ 3.6 million in 1954 and £ 19.6 million in 1955, and a surplus of £ 12.8 million in 1956.

The National Coal Board raises capital by long-term borrowing direct from the Exchequer, instead of through the issue of stock. There is a statutory limit of £ 650 million at present on such borrowing and special authorisations is needed for borrowing, in any one year, more than £ 75 million in excess of the highest level of aggregate advances in the preceding year.

PRODUCTION

It has been estimated that Britain has workable reserves of coal of 43,000 million tons, more than enough at current rates of consumption to last for 200 years. But certain types such as high quality coking coal will be exhausted long before then unless they are eked out by blending with other types of coal.

The main coal-bearing areas are: (1) the Yorkshire, Derbyshire and Nottinghamshire field which produces about 40 per cent of the total output, (2) the Durham and Northumberland field, (3) the South Wales field, and (4) the Scottish field. Other important coal-bearing areas are those of Lancashire and the West Midlands (Staffordshire and Warwickshire). There are no coalbearing areas in Northern Ireland.

In the years since nationalisation the National Coal Board has been able to secure quick increases in production and productivity by reorganisation, by a wider application of improved working methods and by increased mechanisation of cutting and conveying. As a result, deepmined production increased from 187.2 million tons in 1947 to 214 million tons in 1954 despite a fall of 4,000 in average manpower. In 1956, 210 million tons was produced from deep mines, which, with 12 million tons from opencast workings, gave a total of 222 million tons. Productivity of all workers increased between 1947 and 1956 from 1.074 to 1.232 tons per manshift.

Future progress depends on bringing new mines into production, the development of machines for power-loading the coal at the face on to the face conveyor belt and on the reorganisation of the haulage systems by carrying out major reconstructions. The National Coal Board has launched a large programme of major reconstruction and new sinkings.

Since the war the coal industry has suffered from a shortage of manpower. In 1956 manpower averaged 703,400 about 9,000 fewer than the industry needs.

MARKETING

The principal marketing officials of the Board are also officers of the Minister of Power's Coal Supplies Organisation, whose function is to apportion the coal to consumers according to the Minister's determination of the national interest.

The Board, as sole producer, is bound to make the first sale of coal. It has, however, no monopoly of distribution, though it does act as a wholesaler and, in the colliery areas, makes direct sales to consumers. Retail distribution is for the most part carried on by private firms, but the price structure is controlled by the Ministry of Power.

CONSUMPTION AND EXPORTS

Although the level of coal production has risen appreciably since 1946, inland consumption has risen even faster—mainly because of the expansion of industrial output. In consequence, the proportion of output which is exported has greatly declined, compared with pre-war, in spite of a virtually unlimited demand for exports of British coal. Exports (excluding bunkers) rose from 4.5 million tons in 1946 to 13.9 million tons in 1949. In 1955 and 1956, exports were deliberately cut to 12.0 million tons and 8.4 million tons respectively.

The greater part of exports of British coal is sent to Europe, and especially to Denmark, Sweden, Germany, the Irish Republic and Italy. Nearly all Britain's coal exports since the war have been covered by trade agreements, and the National Coal Board has sought to honour its old customers even when that has meant importing coal at great expense from Europe and the United States and selling at a loss at the prevailing internal prices. Imports in 1955 amounted to 11.4 million tons, in spite of the reduction in exports, but in 1956 were reduced to 5.2 million tons.

LABOUR RELATIONS

Negotiations on wages and conditions of service are conducted through a Joint National Negotiating Committee, consisting of 16 members appointed by the National Coal Board and not more than 16 members of the National Union of Mine-workers. Disputed issues are referred to a National Reference Tribunal consisting of three permanent independent members and four assessors without voting rights, two representing labour and two management. There are also District Joint Negotiating Committees, which deal with the application of national agreements, settle any difficulties and differences that may arise at district level and refer unresolved differences to the national committee.

The Coal Industry Nationalisation Act requires the Board to enter into joint consultation with its employees to discuss such matters as production, safety, health and welfare. At almost every colliery there is a Consultative Committee in which the workmen's representatives are elected by secret ballot. The colliery manager is chairman, and he nominates three colliery officials to be members of the committee. There are also Consultative Councils at the area, divisional and national levels on which the Board and the four staff organisations in the industry —the National Association of Colliery Managers, the British Association of Colliery Management, the

National Association of Colliery Overmen, Deputies and Short-firers, and the National Union of Mineworkers—are represented.

SAFETY, HEALTH AND WELFARE

The safety, health and welfare of miners are safeguarded by comprehensive legislation, which was consolidated and brought up to date by the Mines and Quarries Act, 1954. Responsibility for the enforcement of safety regulations lies with the Mines and Quarries Inspectorate of the Ministry of Power.

The National Coal Board has its own safety organisation and, in accordance with the Nationalisation Act, follows a policy directed towards securing the safety, health and welfare of its employees, examples of voluntary action by the Board to reduce risks are the installation of fire-resistant conveyor belts, the replacement of light alloy supports (which has been found to be liable to produce dangerous sparks) and the wide-spread introduction of courses for training for various classes of officials and workmen. The Board has also continued to strengthen the medical services which existed before nationalisation. Chief Divisional and Area Medical Officers have been appointed and Assistant Medical Officers are being appointed in areas with a labour force of more than 15,000 men. Medical centres are being set up at the pit head.

The Board is responsible for its employees' welfare at their work-places, for example, by the provision of pithead baths and canteens, which the social welfare of coal-miners and their families has, since 1952, been the responsibility of the Coal Industry Social Welfare Organisation, which is controlled by the Board and the miners' trade unions.

Research into problems of safety and health is carried out also at the Ministry of Power's Safety in Mines Research Establishment, which maintains a close liaison with the Mines Inspectorate and the National Coal Board's research organisation.

DEVELOPMENT AND RESEARCH

Contraction and curtailment of development in the industry since the peak year, 1913, had led to a position in which less than one-third of current output was coming from pits started in the twentieth century. Large-scale development was therefore essential.

In 1950, the National Coal Board announced its long-term plan of development for the industry, involving the reorganisation and increased mechanisation of existing mines and the sinking of new ones. The plan envisaged a capital investment of £ 635 million at 1949 prices between 1950 and 1965, when it was estimated that the annual output of coal would have risen to about 240 million tons. The plan was not a rigid blueprint, room being left for modifications in the light of changing circumstances and new knowledge. Actual capital expenditure in the years 1950—54 was £ 258 million at current prices. Under a revised plan issued in May 1956, the Board provides for an output of 228 million tons in 1960 and 240 million tons in 1965. An annual output of 250 million tons is not thought possible before 1970. Opencast production is expected to continue at a rate of about 10 million tons a year. The capital cost of achieving these output figures, and of providing the money for major schemes to be completed after 1965, is estimated at £ 860 million for collieries and their associated activities. In addition, the Board proposes to spend £ 140 million on ancillary activities. A total of £ 590 million will be spent between 1956 and 1960 and £ 410 million in 1951—65. Manpower requirements are estimated at 682,000 with an output-per-man-year of 319 tons in 1960, and 672,000 with an output-per-man-year of 342 tons in 1965. When the programme is completed, four-fifths of Britain's coal will be coming from virtually new mines.

The mechanical cutting and conveying of coal are now the general practice: in 1956, 87 per cent of total deepmined output was mechanically cut and 93 per cent was mechanically conveyed. The loading of coal at the working face offers, at present, the next most important possibility for increased coalface mechanisation. In 1956, 36.4 million tons were power loaded, compared with 13 million tons in 1953 and 5 million tons in 1947.

In 1947, the National Coal Board took over, with other assets, the Coal Survey, a national organisation for surveying coal resources within Britain, and 70 laboratories in the various coalfields, which it has since extended and modernised.

In 1948, the Board established a central research organisation at Stoke Orchard, near Cheltenham, Gloucestershire, to provide facilities for fundamental research in the coalmining industry, as distinct from the day-to-day scientific control exercised by the divisional and area scientific organisation. This is now known as the Coal Research Establishment. A second

central research organisation for the investigation of underground problems, known as the Mining Research Establishment, was formed in 1952 by the Board at Isleworth, Middlesex, and a Central Engineering Establishment is now operating near Bretby in Derbyshire for developing new machines and testing equipment.

The Board also subscribes to a number of autonomous research associations in receipt of grants from the Department of Scientific and Industrial Research (DSIR), including the British Coal Utilisation Research Association, the British Coke Research Association and the Coal Tar Research Association. In addition much of the work of other bodies, such as the Safety in Mines Research Establishment of the Ministry of Power and the Fuel Research Station of DSIR, is closely related to the Board's problems.

From 1st July 1956, the National Coal Board and the Central Electricity Authority have accepted responsibility for the planning and construction of a pilot plant for the underground gasification of coal. This is a process for converting coal in the ground into gas for use in generating electricity and it has reached the stage of being demonstrated on a small scale after 6 years of work by the Ministry of Power in co-operation with the National Coal Board. Exploitation of the process on a commercial scale is being undertaken. The National Coal Board has set up an Underground Gasification Executive to carry out its part in the project.

PETROLEUM

The petroleum industry in Britain dates back to 1850, when Dr. James Young, a Glasgow chemist, succeeded in obtaining lamp oil and lubricants from natural mineral oil occurring in the Derbyshire coal measures. The Scottish shale deposits, yielding similar products, were first worked in 1858.

INDIGENOUS PRODUCTION

Sources of crude oil within Britain (including shale oil) supply altogether less than one per cent of total United Kingdom requirements, the remainder being imported from overseas.

Current output of shale oil is drawn from 7 shale mines and one opencast quarry, retorted in four crude oil works, and the crude products are refined in a central refinery at Pumpherston, near Edinburgh. Output of shale reached a peak of 3.4 million tons in 1913, but the cost of the processes and other economic difficulties led to a reduction of output. This amounted to over 1 million tons in 1956, yielding some 79,000 tons of crude shale oil. From the latter, some 63,000 tons of refined products were obtained. In 1956, some 84,000 tons of motor and aviation spirit were obtained from coal by hydrogenation, and 314,500 tons of refined benzole from coke ovens and gas works. Prospecting for crude petroleum has so far led to the establishment of oilfields in Nottinghamshire (small amounts of oil were found in further borings at Plungar in Leicestershire in 1953), and one in Lancashire. Production of crude oil in 1956 was 66,000 tons.

INTERNATIONAL TRADE

British and British-Dutch oil companies have been responsible for developing the oil resources of many countries to mutual advantage, especially in the Middle East, Far East and Caribbean areas.

Today they produce one-third of all oil entering into international trade, with a tanker fleet (part owned by them and part on charter) amounting to nearly one-third of the world's tanker tonnage. (United Kingdom registered tanker tonnage is nearly one-fifth of the world's total.)

CONSUMPTION

Consumption of petroleum products in the United Kingdom has risen from almost one million tons in 1900 (mostly kerosene for lamps, and lubricants) to over 25 million tons in 1956 (predominantly gas, diesel and fuel oils and motor spirit).

REFINERIES

Up to 1939, three-quarters of the United Kingdom's supply of petroleum products was refined overseas, in accordance with the view, commonly held in the world oil industry at that time, that it was more economical to refine at the source of production. Since the second world war, however, the industry has come to favour the siting of refineries in the consuming areas. In this it has had Government support, both because of the need to save foreign exchange and because of the extra employment and other advantages to the economy resulting from the new development. The expansion programme in the United Kingdom carried out by the major oil companies was a substantial one, costing over the years 1947 to 1954 very nearly £ 200 million.

At the end of May 1957, refinery capacity in the United Kingdom amounted to almost 31 million tons a year. Plans for a second major phase of expansion to bring this up to at least 39 million tons by 1958 have been announced by some of the leading companies. Actual production of refined products rose from about 5 million tons in 1948—49 to 28.7 million tons in 1956. Exports of refined products became possible, and their value reached £ 84 million in 1954 and £ 99 million in 1956. Imports of refined products were valued at £ 87 million in 1954 and £ 126 million in 1956, compared with £ 141 million in 1951.

RESEARCH

Research into problems of petroleum technology is carried out mainly by the leading oil companies, which have also endowed research at the universities on a substantial scale. Some work on the production of oil products from coal is done at the Fuel Research Station of the Department of Scientific and Industrial Research.

ELECTRICITY SUPPLY

Public supply of electricity was first provided at Godalming, Surrey, in 1881, though there were earlier demonstrations of its use to consumers, such as the former Metropolitan Board of Works, in the lighting of the Thames Embankment. From the earliest days a measure of public control has been a feature of the industry, and the Electric Lighting Act of 1882 authorised the Board of Trade to grant licences for the establishment of electricity undertakings by local authorities or by companies (which the local authorities might compulsorily purchase after a given period of time) to supply consumers in given areas. By the turn of the century, technical developments, including the introduction of the electric motor as a source of motive power, had led to a large increase in the scale of distribution of electricity, and a variety of independent supply systems had grown up all over the country.

It was not until after the first world war that steps were taken to reorganise the industry on a national scale in oder to realise the benefits of concentration, integration and standardisation in electricity supply. In 1919, the Electricity Commissioners were set up as a supervisory body and to promote reorganisation through voluntary agreement. Then, in 1926, the Central Electricity Board was established to co-ordinate more efficiently the generation of electricity. Its main duties were to concentrate the output of electricity in certain stations, selected for their efficiency and low operating costs, and to connect these selected stations with one another and with local distribution undertakings by means of a national system of main transmission lines, known as the Grid. Thenceforward, steady progress was made in putting this plan into effect and, by March 1948, 143 selected stations, out of some 300, were supplying 95 per cent of the electricity generated for public supply.

ORGANISATION UNDER PUBLIC OWNERSHIP

With the exception of a few small non-statutory undertakings accounting for less than one per cent of the electricity consumption, the public supply of electricity in Great Britain is now exclusively in the hands of public corporations: in England and Wales, the Central Electricity Authority is responsible for generation, and 12 Area Boards for distribution; and in Scotland, the North of Scotland Hydro-Electric Board and the South of Scotland Electricity Board are each responsible for generation and distribution in their respective areas. In Northern Ireland, electricity is supplied by two municipal undertakings and one public board.

Under the Electricity Act of 1947, a central authority, then known as the British Electricity Authority, and 14 Area Electricity Boards, took over in April 1948 the assets of former municipal and private electricity supply undertakings throughout Great Britain, except in the area already served by the North of Scotland Hydro-Electric Board (see below). Under the Electricity Reorganisation (Scotland) Act of 1954, the Authority's functions in Scotland were taken over in April 1955 by the South of Scotland Electricity Board (see below) and the name of the Authority was changed from British Electricity Authority to Central Electricity Authority.

Over 200,000 people are employed in the electricity supply industry.

ENGLAND AND WALES

The *Central Electricity Authority* is appointed by the Minister of Power and is responsible to him for the general policy of the whole electricity supply industry in England and Wales. Its main function is to develop and maintain an efficient co-ordinated and economical system of electricity supply, and it is responsible for the generation and bulk supply of electricity to the Area Boards.

The *Area Boards* (of which there are at present 12) are responsible for the distribution of electricity in England and Wales. Each consists of a full-time chairman and deputy chairman and four to six part-time members, appointed, as are the members of the Central Authority, by the Minister of Power.

Area Consultative Councils have been set up in the area of each Area Board to represent the interests of consumers. They each consist of between 20 and 30 members, of whom between 50 and 60 per cent are nominated by local authority associations. The chairman of each Area Consultative Council is an *ex officio* member of the corresponding Area Board. There are also Consultative Councils for each of the districts of the two Scottish Electricity Boards and the chairman of each is a member of the respective Board.

Finance. The Central Authority and Area Boards, taken together, have made a consolidated net surplus on their operations in each of the years since they were established. Up to and including the financial year 1955–56, these surpluses amounted in the aggregate to over £ 70 million.

Labour Relations. Under the Electricity Act, 1947, the Central Authority is required to devise a satisfactory procedure for collective bargaining and joint consultation with its employees. In each of the three main groups of workers (administrative, technical and manual), there is a separate National Joint Industrial Council or Board, which negotiates terms and conditions of employment. A National Joint Advisory Council, drawn from management and employees, has been set up to discuss the health, welfare and safety of all groups of employees. There are also separate district councils and local works and advisory committees forming part of the negotiating and conciliatory machinery.

Proposals for Reorganisation. In November 1956, the Government published a White Paper (Cmnd. 27), putting forward proposals, based on the report of the Committee of Inquiry into the Electricity Supply Industry (Cmd. 9672), for the reorganisation of the electricity supply industry in England and Wales. These proposals have been embodied in the Electricity Act, 1957, and will take effect on 1st April, 1958. The Central Electricity Authority will then be replaced by an Electricity Council, which will advise the Minister of Power on questions affecting the electricity supply industry and promote and assist the maintenance and development, by a new Central Electricity Generating Board and by Area Boards, of 'an efficient co-ordinated and economical system of electricity supply'. The responsibility for generating and supplying electricity in bulk will be placed on the Generating Board. Appointments to the Council and Board were announced in August, 1957.

Greater autonomy for Area Boards is proposed. The Generating Board and each Area Board will be required by law to balance their accounts individually, in order to encourage financial responsibility and a critical attitude towards costs. The industry's central reserve fund will be wound up and distributed to the Area Boards, each of which will maintain its own reserve fund.

The most important functions of the Minister, under the new arrangements, will be to appoint the chairman and deputy chairman of the Electricity Council and the members of the Generating Board (the other members of the Council will be the chairman of the Area Boards and one other member representing the Generating Board); to approve each Area Board's capital development plans and the industry's research programme; and to approve, in consultation with the Treasury, the Board's borrowing requirements, having regard to the development programmes submitted by the industry. The Minister also has power to issue general directions to the Council and the Boards if he considers this necessary in the national interest. It is also proposed to strengthen the Consultative Councils.

SCOTLAND

The *North of Scotland Hydro-Electric Board* was set up in 1943 as a non-profit-making body to develop the water power resources of the Highlands and Islands and to distribute electricity in the more sparsely populated parts of Scotland not covered by existing undertakings. It is a non-functional board, consisting of a chairman, deputy chairman and not fewer than three nor more than seven other members who are all part-time members without departmental responsibilities, appointed by the Secretary of State for Scotland.

The Act of 1947 made the North of Scotland Hydro-Electric Board solely responsible to the Secretary of State for Scotland for all generation and distribution in its area. This area was extended under the Act to include that part of Scotland north and west of a line running roughly from Dumbarton on

the Firth of Clyde to Newburgh on the Firth of Tay. In the rest of Scotland, the Central Authority, then known as the British Electricity Authority, together with the South-East and South-west Scotland Electricity Boards, was responsible to the then Minister of Fuel and Power in all electricity matters.

On 1st April, 1955, the *South of Scotland Electricity Board,* answerable to the Secretary of State for Scotland, took over the Central Authority's functions in Scotland, and also the functions of the two Scottish Area Boards, which were dissolved. The Board consists of a chairman, deputy chairman, two full-time and five part-time members. Under the Electricity Reorganisation (Scotland) Act, 1954, the then Minister of Fuel and Power retained only three functions in regard to electricity in Scotland, namely, to act jointly with the Secretary of State in regard to staff pensions and safety measures, and to remain solely responsible for the certification of meters.

NORTHERN IRELAND

In Northern Ireland, the bulk of electricity is acquired by the *Northern Ireland Joint Electricity Committee* set up by statute in 1948, for sale to statutory distribution undertakings. Of these the *Electricity Board for Northern Ireland* distributes electricity throughout the country with the exception of the cities of Belfast and Londonderry, where it is carried out by municipal undertakings.

GENERATION

Almost the whole of Britain's electricity is produced in coal-fired steam generating stations. Abundant supplies of coal, together with good rail and water transport for moving it, in contrast with the remote and scattered location of relatively small water power resources, led to this preponderant development of electricity supplies from thermal generating stations. The development of hydro-electricity on any scale is comparatively recent.

The setting up of the North of Scotland Hydro-Electric Board in 1943 marked the beginning of a new era of intensive water power development in the Highlands of Scotland. A development scheme

NEW TYPE AIRCRAFT REFUELLER GOES INTO OPERATION AT SANTA CRUZ AIRPORT

An aircraft refueller of a type and size to be built in India for the first time, was put into operation by Stanvac at the Santa Cruz airport.

In constructing this new refueller unit known as the step-down semi-trailer type, Stanvac engineers have disproved the long-held belief that such units could not be manufactured in India.

The unit which incorporates the very latest features developed and tested thoroughly in the United States, has a tank capacity of 2400 I. G.

While the trailer fuel tank is usually tilted in the common type of refuellers, the " step down " design of this new refueller enables the placing of the tank parallel to the ground.

Another departure from convention has been in the designing of the tank. Usually tanks are built on a frame or a " skeleton ". The tank trailer of this new refueller is frameless. This not only reduces the weight of the unit, but enables it to carry more product relative to the amount of steel used. Because its design lowers the centre of gravity in the trailer, it makes for easier and safer driving and gives added manoeuvrability to the whole unit.

In order to give added strength to the tank, one piece dished baffles and special fabricating technique involving " lap welding " were used. This involved the fabrication, also for the first time in India, of a one piece dished baffle of perfect bend and obtaining a perfect lap for lap welding.

The refueller is fitted with the latest aviation servicing equipment which gives the unit the maximum pressure and flow control so that it moots the exacting refuelling requirements of such modern types of aircraft as the Viscount. Quality-control devices fitted to the unit are as modern as those used anywhere in the world.

The total cost of the unit was about Rs. 85,000 roughly twenty-five per cent less than the imported units, and about half the total cost involved represented a saving of foreign exchange.

The fabrication of this new type of refueller is part of Standard-Vacuum's programme of modernising their aviation service equipment, commenced three years ago. In implementing this programme, seven flat top refueller units were imported in 1956 and five additional units were scheduled to be

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drawn up by the Board in 1944, showing the water power resources which it proposed to examine, listed 102 hydro-electric projects with an estimated annual output of 6,274 million units of electricity The ultimate output of Highland hydro-electric power is expected to be substantially higher and eventually may exceed 10,000 million units. In 1956, 1,282 million units were generated from water power compared with 322 million in 1949.

In 1956, 85,326 million units (one unit = one kilowatt-hour), or nearly 98 per cent of the public supply in Great Britain, was generated at steam stations, 1,667 million units, or 1.8 per cent, from water power, and 168 million units by other means, e. g., diesel and waste heat and refuse destruction. The high rate of expansion of output, which has been a feature of the industry since its earliest years, has been continued since the war. Total production in 1956 was eight times what it was in 1930 and has increased in nearly every year and especially since 1953.

The installed generating capacity of the electricity authorities (including the North of Scotland Hydro-Electric Board) in Great Britain at the end of 1956 totalled 24.615 megawatts (maximum continuous rating) compared with 12,546 megawatts at the end of 1948. The Central Electricity Authority is planning a large-scale programme of capital investment for the regions it controls, which makes provision for an increase, between the years 1957 and 1961, of 9,400 megawatts (sent out).

Sales of electricity in Northern Ireland (where the total generating capacity of 391 megawatts is in coal-fired thermal stations) amounted to 956 million kilowatt-hours in 1956, when the maximum load sustained was 335 megawatts. Further plant installations, with a generating capacity of 60 megawatts, are due to be completed in 1957—58.

The Central Electricity Authority is the largest consumer of primary fuel in Britain and in the year ended 31st March, 1957, it used just over 42.7 million tons, consisting mainly of coal. Average thermal efficiency of steam stations (i. e. the ratio of power output to the coal consumed) rose from 20.91 per cent in 1947—48 to 24.93 per cent in 1955—56 as new plant was brought into use. Twenty stations containing much of the newest plant had an average efficiency of 29.14 per cent in that year.

To meet increasing demands for electricity and to save coal, generation from alternative fuels is being actively promoted. The chief alternatives are expected to be oil, to a small extent peat, and nuclear energy. As regards oil, dual firing apparatus able to use either coal or oil has been fitted to a new power station at Marchwood, on Southampton Water, and similar apparatus is to be installed in other power stations similarly situated on river estuaries and thus able to be fed conveniently from nearby oil refineries. The use of peat has been advocated in Scotland, as in Northern Ireland, as a source of power and as a means of making land available for agriculture. In July 1953, the Government announced that it had accepted a recommendation of the Scottish Peat Committee, appointed in 1949 to advise on the development of Scottish peat deposits, that an experimental peat-burning station for generating electricity should be established in Caithness. A pilot project covering some 300 acres at Altnabreac, Caithness, has been started. A peat-burning gas turbine, developed by a Scottish firm with assistance from the Development Fund is coming into operation in 1957. As the peat is cleared from the bog, the land is made available for farming.

NUCLEAR POWER STATIONS

Nuclear power stations are being built for both the United Kingdom Atomic Energy Authority (UKAEA) and for the Electricity Authorities.

As an extension of its experimental work and to produce plutonium, the UKAEA has built and is building a number of reactors which also produce electricity on a reasonably large scale. Most notable of these is the Calder Hall nuclear energy establishment in Cumberland which, since 17th October, 1956, when it was officially opened by the Queen, has been the first large-scale nuclear power station in the world to supply electricity to a national electrical network. Calder Hall A, consisting of two reactors, has an installed capacity of 92 megawatts (MW); Calder Hall B, due for completion in 1958, will double the installed capacity. Four more similar reactors are being built at Chapel Cross, near Annan in Dumfriesshire, Scotland. A further establishment at Dounreay, Caithness, Scotland, started in 1954 and now on the way to completion, houses breeder reactors which will produce electricity.

A provisional programme of commercial nuclear power stations for the Electricity Authorities was published in a White Paper (Cmd. 9389) by the Government in February 1955. This envisaged

spending £ 300 million on building 12 nuclear power stations, together with the necessary ancillary services, uranium and prototype development in the ten years 1955—65. Between 1,500 and 2,000 megawatts of electricity would be produced by this means by 1965, saving 5—6 million tons of coal a year.

Since the publication of the 1955 programme, two factors have led to a reassessment of the targets provisionally set : rapid technological advance, which has already made possible stations of more than four times the installed capacity of Calder Hall ; and increased imports of fuel, chiefly oil, to meet increasing energy requirements accentuating the burden on the balance of payments.

Accordingly, on 5th March, 1957, the Government announced a revised programme of nuclear power, under which nuclear energy would be providing 5,000—6,000 megawatts of electricity by 1965, instead of 1,500—2,000 megawatts as originally planned, the equivalent of 18 million tons of coal (or ten million tons of oil) a year used in conventional stations for a similar output. During the decade ending in the year 1965–6 the total capital investment by the Electricity Authorities of fulfil the combined nuclear and conventional power station programme (including ancillary transmission facilities) might be of the order of £ 3,350 million. This would compare with an estimate of £ 2,600 million during the decade for purely conventional stations ; of the difference of £ 750 million, some £ 200 million might be accounted for by the procurement of the initial charges of uranium.

By the end of August 1957, work on two stations—at Bradwell in Essex (300 MW installed capacity) and at Berkeley in Gloucestershire (275 MW)—was well advanced. At Hunterston in Ayrshire, Scotland, work had begun on a site for a third station. The building, at Hinkley Point, Somerset, of a fourth station (500 MW) was under negotiation, and sites in North Wales for two further stations were being considered. The Northern Ireland Electricity Board had decided to build a station of 150 MW, for which sites were then being examined.

TRANSMISSION AND DISTRIBUTION

Main electricity transmission lines—the Grid—cover most of the country. Those of the Central Authority totalled at 31st March, 1957, 5,500 route miles (8,602 circuit miles) of which 415 miles were operated at 275,000 volts, 4,635 miles were operated at 132,000 volts and the remainder at 66,000 volts and below. The reduction over the previous year was due to the transfer of a section to the South of Scotland Electricity Board. In the North of Scotland district there were 1,480 circuit miles of main transmission lines at the end of 1956, all operated at 132,000 volts. Control of energy movements on the Grid in England and Wales is managed through the eight operational areas, set up by the Authority for that purpose and distinct from the divisions in which the generating side of the industry is organised ; each area has a central control station and the operations are co-ordinated by a control station in London. The Grid in Scotland is operated from the North of Scotland control centre at Tummel Bridge and the South of Scotland control centre at Glasgow.

The new Supergrid of main transmission lines at 275,000 volts will assist in meeting the growing demand for electricity during the next 20 years with the greatest economy and will make the British electricity supply the most closely integrated power network in the world. The first stage was completed in 1954.

In September 1956, a joint committee of the Central Electricity Authority and Electricite de France recommended the adoption of a scheme for interchange of energy by direct current by means of a single cable capable of transmitting between 120,000 and 150,000 kilowatts at 200,000 volts, and the scheme is being undertaken. It was hoped to begin work on the project in 1957 and to complete it by 1960 at a cost of about £ 5 million. The object of the scheme is to take advantage of the differences in the incidence of peak periods in the two countries.

The Area Electricity Boards distribute to consumers electricity acquired mainly from the Authority, but in part from other sources, e. g. collieries. There were 14.5 million consumers in December 1956, and increase of about 5 million on those supplied in December 1939. Industrial users are the group of consumers with the highest consumption, and demand from this sector is increasing rapidly. The principal domestic uses of electricity are for lighting, cooking, and for space and water heating, but the demand for numerous other domestic purposes is increasing.

The development of electricity supplies for rural areas has been facilitated by the change in the structure of the industry under the 1947 Act. During the year ended 31st March, 1957, supplies were

provided for a further 13,135 farms which raised the number of farms provided with electricity to over 188,059 out of a total of 272,000 farms.

The North of Scotland Hydro-Electric Board has also pressed ahead with the distribution of electricity to consumers in the North of Scotland. At the end of 1956, there were 351,524 consumers of electricity in the Board's district and 55.5 per cent of the farms and 55.4 of crofts in the district had a supply of electricity.

DEVELOPMENT AND RESEARCH

The comprehensive capital development plan to bridge the gap between ever increasing demand and supply is limited by shortages of equipment and finance. The borrowing powers of the Central Electricity Authority and Area Electricity Boards were originally limited to a maximum of £ 700 million, but in 1954 were extended to £ 1,400 million. Capital expenditure during 1956 by the Authority and Area Boards was about £ 209 million and approved expenditure for 1957 amounted to £ 233 million. The original investment plans of the Authority have been considerably modified by the programme of nuclear power development, outlined on pp. 10—11 inasmuch as it is conceivable that, from the middle of the 1960s, most new plant will consist of nuclear-powered stations.

Borrowing by the North of Scotland Hydro-Electric Board is limited by the Electricity Act, 1947, as amended by the Hydro-Electric Development (Scotland) Act, 1952, to a maximum of £ 200 million. Borrowing by the South of Scotland Electricity Board is limited by the Electricity Reorganisation (Scotland) Act, 1954, to a maximum of £ 75 million.

The Central Electricity Authority undertakes research on its own account and helps to finance research through its membership of the British Electrical and Allied Industries Research Association, an organisation to which manufacturing firms and large consumers of electricity also belong and which was established before the supply industry passed into public ownership. This Association is one of the 44 autonomous research associations in receipt of grants from the Department of Scientific and Industrial Research. The Central Electricity Authority also has an Electrical Supply Research Council including independent experts to advise it and the Area Boards, and can consult the Minister of Power's Scientific Advisory Council on problems affecting the supply and use of electricity. Direct research on a laboratory scale takes place at the Central Electricity Laboratories at Leatherhead, Surrey, extensions to which were opened by the Authority in July 1950. Examples of research include gas turbine generation and experiments in the use of wind power for generation.

As part of its programme of power station construction for 1962, the Central Electricity Authority plans to install a turbo-generator of 550,000 kilowatt capacity—much larger than any now in operation, or, as far as is known, than any at present projected anywhere in the world. The decision to build a machine of this large capacity is the latest step in a programme aimed at reducing cost of generation by increasing the size of generating sets and boilers. Work is in progress on even more advanced machines for subsequent programmes.

GAS SUPPLY

Public supply of gas in Britain dates from 1807, when Pall Mall, London, was first lighted with gas. In 1812 the London and Westminster Gas Light and Coke Company received a Royal Charter to supply gaslight in London. In the early years of the industry, gas was used almost exclusively for lighting and was provided by a growing number of company and municipal undertakings. Then, after the middle of the century and the invention of the Bunsen burner in 1855, gas was used increasingly as a source of heat for many purposes, such as domestic cooking and space and water heating, in addition to a number of industrial uses. After 1880, however, gas for lighting purposes was subjected to increasing competition from the new electricity supply industry; but the invention of the Welsbach incandescent mantle in 1887, which raised the efficiency of gas lighting very considerably, enabled the industry to hold its own while the supply of gas for purposes other than lighting increased.

The gas industry in its present form developed in the main during the period between the wars when increasing competition from electricity had to be met and when changes in social habits and outlook were taking place. The industry undertook a large-scale programme of modernisation of production and distribution and launched wide-spread sales promotion campaigns especially for the numerous uses of gas in the home. By 1939 the industry had become mainly a supplier of heating instead of a supplier of lighting.

ORGANISATION UNDER PUBLIC OWNERSHIP

Under the Gas Act, 1948, the gas industry was brought under public ownership and control on 1st May, 1949. The assets of 991 undertakings, of which 269 belonged to local authorities, were vested in 12 Area Gas Boards. Together they cover the whole of Great Britain and are charged with a statutory duty to develop and maintain an efficient, co-ordinated and economical system of gas supply to domestic, industrial and other consumers. The national body is the *Gas Council*, which is appointed by the Minister of Power and is responsible *inter alia* for advising him on questions affecting the gas industry. It is a co-ordinating council, not a trading body. It consists of a full-time chairman and deputy chairman and the twelve chairmen of the Area Boards.

The *Area Gas Boards*, which have a large measure of financial and operational responsibility and are similar in most respects to the central bodies of the other publicly owned corporations, are charged *inter alia* with the responsibility of manufacturing and distributing gas to consumers. Thus, their powers differ from those of the Electricity Area Boards, which are limited to the distribution and sale of current, while the central executive body—the Central Electricity Authority—is charged with the duties of generation and transmission. Each of the Area Gas Boards which, like the Gas Council are appointed by the Minister of Power, consists of a full-time chairman and deputy chairman, in some cases one, and in one case two, full-time members, and always five or six part-time members including the chairman of the Area Consultative Council. There is no common pattern of organisation; each Board is fully independent and has devised its own subordinate structure.

A link between the industry and the consuming public was established under the nationalisation scheme by the creation of a *Consultative Council* in each board area. These councils consist of not fewer than 20 and not more than 30 members, of whom between 50 and 75 per cent are chosen from panels of persons nominated by the local authority associations.

In Northern Ireland, the gas supply industry remains in the hands of a number of municipal undertakings and statutory and non-statutory companies.

As has been said, the Gas Council is not a trading body, but the operations of the Area Boards have

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imported the following year. In view of the difficult foreign exchange positions, Stanvac initiated a plan to fabricate the refuellers locally, strictly limiting imports only to those parts or equipment which were impossible to obtain or manufactured in India. In addition to the unit that has just been commissioned, Stanvac is building another eight new units to complete the five that were to be imported under the 1957 programme, and the rest to cover the current year's requirements.

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ELECTRIC LOCO FOR INDIA SHIPPED FROM U. K.

The first of 12 electric locomotives designed for use on the Eastern Railway in India has just been shipped from Liverpool. This powerful locomotive—of 3,120 h. p.—has been built by the Vulcan Foundry Ltd., a pioneer in the field of locomotive construction and now one of the companies of the English Electric group.

At the present time its electric traction equipment is operating over the railway systems of 29 countries, and the English Electric group has also carried out complete electrification contracts in India, Japan, Brazil, Morocco, and many other countries in various parts of the world.

Motor-coach trains built by English Electric are in operation on the electrified Madras suburban services and also in Bombay, while locomotives of 3,600 h. p. are being delivered for the operation of passenger and freight services on the electrified main lines from Bombay to Poona and Igatpuri.

Besides handling the Indian Government contract, the English Electric group is at present producing rail traction equipment for the railway systems in Britain, South Africa, Nigeria, Rhodesia, Australia, New Zealand, and the Netherlands.

resulted in the seven years up to 31st March, 1956, in an aggregate disposable surplus of over £ 13.5 million.

LABOUR RELATIONS

Under the Gas Act, 1948, the Gas Council is responsible for arranging satisfactory procedures of collective bargaining and a system of joint consultation with its employees. There are separate Joint Industrial Councils at the national level for manual workers and salaried staffs, and subordinated regional councils and local committees. At national and regional levels the councils combine negotiating and consultative functions, but there are in some cases separate Consultative Committees at the local level.

PRODUCTION

In 1956, in Great Britain 27.7 million tons of coal were carbonised by gas undertakings and 29.5 million tons by coke ovens operated outside the gas industry. About one-quarter of the output of gas from coke ovens is sold to gas undertakings for general distribution; the remainder is mainly consumed at the ovens or at collieries or steelworks.

In 1921, 250,300 million cubic feet of gas was manufactured by authorised gas undertakings or acquired from coke ovens, and the number of consumers was 7.6 million. By 1955, gas manufactured and acquired from coke ovens for distribution had risen to 2,912 million therms and the number of consumers had risen to about 12.8 million, an increase of 140 per cent in the volume of gas available and of about 67 per cent in the number of consumers.

In 1956, the quantity of gas produced in Northern Ireland was 7,625 million cubic feet, most of it for household use.

The total number of persons employed in the gas industry in March 1957 was 140,300.

CONSUMPTION

Half of all gas produced is sold for household use and the remainder for industry, commerce and public services.

Domestic Use While an accurate statistical analysis of the domestic load is not possible, evidence given before the Ridley Committee (on Fuel and Power Policy), appointed by the then Minister of Fuel and Power in 1951, suggested that about 70 per cent of the domestic load was used for cooking, the remaining 30 per cent being spread over space heating, water heating and other installations. Most homes in Britain are now supplied with gas, except in some rural areas where, owing to difficulties in storage and transmission, gas is not economic. These difficulties have been overcome to some extent by the use of local high-pressure storage tanks but this development is unlikely to grow, owing to the steady extension of rural electricity supplies. Bottled gas, derived from petroleum, is widely used in rural areas.

Industrial and Commercial Use Gas is used extensively in industries which require a simple control of temperature to a fine degree of accuracy. Among such industries are pottery and certain processes in the manufacture of iron and steel products. Industrial use of gas increased greatly during the second world war and reached 103,000 million cubic feet in 1943. By 1956 industrial consumption is estimated to have reached 759 million therms.

BY-PRODUCTS

With the rapid increase in the volume of gas produced, the problems of the disposal of substances which were regarded originally as the ' waste ' products of the carbonisation of coal (notably tar, benzole, sulphur and ammonia) became increasingly important.

Production of coke at gas works in 1956 was 12.7 million tons, and at coke ovens 19.5 million tons. The gas industry and coke ovens jointly produce over 2.9 million tons of crude coal tar and about 110 million gallons of crude benzole a year. These products, together with those of the sulphur and ammonia type, provide a source for the manufacture of a long and ever-growing list of essential derivatives which include dyestuffs (of which Britain now produces most of its own requirements), fertilisers, plastics, germicides (the sulphonamides and sulphanilamides), insecticides, refrigerants, perfumes, and synthetic yarns.

With further research and development, more especially in the field of organic chemistry, the production of coal carbonisation derivatives is becoming of increasing importance to the economy of the industry.

DEVELOPMENTS AND RESEARCH

The chief objects of capital expenditure in the years immediately after the war were to overtake arrears of plant renewal. Plans for further expansion were approved by the then Minister of Fuel and Power in 1954 and are outlined in the Gas Council's publication *Fuel for the Nation*.

Under the Gas Act, 1948, borrowing by the Gas Council and the Area Gas Boards was limited to £ 250 million. Borrowings to a total of £ 235 million had been authorised up to 30th June, 1954. The Gas and Electricity (Borrowing Powers) Act, 1954, extended these borrowing powers to £ 450 million.

Capital expenditure in the year ended 31st March, 1956, was £ 61 million, compared, with £ 46 million in 1952—53 and £ 36 million in 1950—51.

The post-war structure of the industry has already permitted considerable integration by the linking of undertakings for the transmission of gas (through gas grids and long-distance mains), enabling production to be concentrated in the most efficient units. Progress is also being made in interconnection for the reception of gas from coke ovens, notably in Wales, Durham and Yorkshire.

Supplies of suitable coal to meet a steadily increasing gas consumption are becoming more difficult to obtain. Investigations into alternative sources of gas are being actively undertaken by the Gas Council. Gases from oil refineries (butane or propane) are used in several installations in smaller towns remote from large gas works or the grid systems. Progress has also been made with the possible use of methane, drained from coal mines. In agreement with the National Coal Board, Area Gas Boards have agreed to schemes for using methane from Point of Ayr Colliery in North Wales and from Haig Pit at Whitehaven, in Cumberland.

Eight oil gasification plants are at present in operation and 20 additional plants are on order. These plants will be capable of producing 82 million cubic feet of gas per day and of saving 850,000 tons of carbonising coal a year. The South Eastern Gas Board and the British Petroleum Company are jointly building a plant to convert petroleum products from the company's Kent oil refinery to gas of acceptable quality. It is expected that the initial installation, which will convert some 50,000 tons of petroleum products a year to gas and will have a daily output of 18 million cubic feet of gas, should be completed by the summer of 1958.

The Gas Council is investing £ 1 million in a five-year survey for natural gas within Britain.

The research organisation established by the Gas Council consists of a research committee, which advises the Council on policy and sees that it is carried out; and two research stations, one in London and one at Solihull, near Birmingham. Research is also carried out on behalf of the Gas Council at Leeds University and by the British Ceramic Research Association (an autonomous research association grant-aided by the Department of Scientific and Industrial Research). Further, the Council and Area Boards support a number of research associations, the work of which has a bearing on the gas industry. These include the Coal Tar Research Association, the British Coal Utilisation Research Association and the National Benzole Association. The underlying aim of the Council's research programme is to 'make the most economic use of the natural resources available to the nation, whether by improvements in existing processes of gas manufacture, by seeking new processes or new sources of supply of gas and by the extraction and use of other products of gasmaking'.

FUEL EFFICIENCY

The Government has for a number of years sought to promote efficiency in the use of fuel, among both industrial and domestic users, and has been assisted by various bodies representative of producers and consumers.

The *Coal Utilisation Council* consists of representatives of the National Coal Board, coal distributors and coal appliance manufacturers. It was formed in 1932 to give information and advice on the best use of solid fuel, including the choice of installation and operation of solid fuel appliances, to domestic consumers and to retailers of appliances. During the second world war, the reduction in coal production and the demands of war industry made economy imperative. When the Ministry of Fuel and Power was formed in 1942, an industrial fuel advisory service with regional branches was incorporated within it. In 1943 the *Women's Advisory Council on Solid Fuel*, consisting mainly of representatives of appliance manufacturers, women's organisations and others interested in the housewife's point of view on domestic fuel arrangements, was formed to advise women on the use of solid fuel for heating and cooking.

Further measures have been taken during the last few years. Under a scheme introduced in 1952, loans on favourable terms are available from the Exchequer to industrialists for financing approved fuel-saving schemes. At present these loans are interest-free for the first two years, repayment may be spread over a maximum period of twenty years and no security is required. In October 1953, a non-profit-making company, known as the *National Industrial Fuel Efficiency Service*, and sponsored by the British Productivity Council, was formed to promote fuel-saving in industry. This company, which largely replaced the industrial fuel advisory service of the then Ministry of Fuel and Power, came into operation on 1st May, 1954. It provides advice and services to all non-domestic fuel users in a variety of forms, from 'spot' inspection to full-scale heat and power surveys and regular visits on a contract basis. A survey of the generation and use of steam carried out by the Ministry has been employed to show the possibilities in the increased uses of back-pressure steam in the generation of electricity. The electricity and gas industries, the largest consumers of primary fuel, are succeeding each year in obtaining more energy from each ton of coal they use, by increasing the thermal efficiency of their plants. The campaign for fuel efficiency is closely linked with the campaign for the reduction of smoke.

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Asia's Largest Rubber Factory Comes of Age

INDIA'S rubber manufacturing industry is destined to play a key part in fulfilling the country's Five Year Plans. Not only in motor transport, but in industry generally and for the supply of consumer goods, the rubber manufacturing industry is today called on to play a responsible part as one of India's basic industries. It is a matter for satisfaction, therefore, that the range of rubber products manufactured in India is continually widening and thus helping the industry to meet the vital requirements of numerous branches of the country's economy.

The growth of this infant industry has been truly remarkable. Barely 20 years ago, India imported the bulk of her requirements of manufactured rubber goods. In 1935—36, these imports were to the value of Rs. 2 crores; by 1950—51, they had dropped to a mere Rs. 33 lakhs and in the same year, goods to the value of Rs. 1.66 crores were exported. The Government of India has permitted the import of tyres and tubes to meet the recent shortages arising out of the greatly increased demand for these products. It is expected, however, that the expansion programmes now under way will help to correct this position in the not too distant a future.

The tempo of economic activity in the country is rising at a rate not known before. This development is very largely due to the growth of heavy industries, power transmission and agriculture, all of which are making increasing demands for rubber products such as rubber covered cables, transmission and vee-belts, conveyor bolting and hoses. But the tyre manufacturing section of the industry will have to face the heaviest demand. It is estimated that a fleet of 1,60,000 trucks will be necessary by the end of the Second Plan period to handle the growing goods traffic by road. The production of motor vehicles and bicycles will also increase. By 1960, 57,000 cars and trucks, 12,000 motorcycles and scooters and 12,50,000 bicycles will be manufactured in India per annum. The tyre industry will be required to meet the original equipment and replacement requirements, and it is estimated that by 1960, the demand for automobile tyres will be 16,00,000 and for bicycle tyres 110,00,000 as against the actual production in 1956 of 9,38,400 and 63,20,400 respectively. Besides tyres and tubes, the industry supplies a large number of vital components required for the modern automobile such as fan belts, radiator hoses, adhesives for body building, latex foam cushioning, etc.

The first rubber factory in India was established almost 32 years after that venerable figure John Boyd Dunlop, invented the first practicable pneumatic tyre. India is the only country in the world where the rubber manufacturing industry is largely fed with indigenous natural rubber. As a result, the industry has firmly taken root within a short period of two decades. The tyre manufacturing section is the mainstay of the industry and large scale tyre manufacture in the country was pioneered by Dunlop in 1936 when they set up a factory in Sahaganj near Calcutta which comes of age this year. The factory was officially opened by Sir John Anderson, then Governor of Bengal, on the 28th November, 1936. Since then, new plant and machinery have been added from time to time to expand the volume and range of products. This factory is now the largest rubber manufacturing enterprise in Asia.

The resiliency of a Dunlopillo mattress being tested mechanically.

During the Second World War, the Dunlop Sahaganj factory gave a creditable account of itself and apart from the rapid expansion in the production of tyres and tubes for cars and trucks, æro tyres and tubes were added to the range. The first major post-War development at Sahaganj was the production of quality cycle rims which was of particular significance in view of the setting up of the many new bicycle factories soon after.

Production of Dunlopillo Latex Foam cushioning commenced in 1951 and in course of the last five years output has gone up four-fold. The increasing use of this material in transport, Assembly Houses, cinemas, hotels, hospitals as well as in the home, promises a great future for this product.

The recent extensions to the Sahaganj factory are of particular interest in relation to the Five Year Plans. The belting and hose plants were officially opened by Dr. B. C. Roy, Chief Minister of West Bengal, in December 1952, and it is now turning out conveyor and elevator belting, transmission and industrial vee belts of the best quality which were mostly imported until recently. Long length braided hose by the lead press moulded process, and a number of special types of hoses, hitherto imported, have been added to the range. Recently, Dunlop initiated an anti-corrosion and abrasion resistant rubber lining service which has already enabled the Railways and other enterprises to save valuable foreign exchange.

In the first Five Year Plan period Sahaganj undertook the manufacture, for the first time in India, of tyres for jet aircraft. Another important project now under way is the installation of plant for the production of large earthmover tyres. Numerous expansion schemes are being implemented at Sahaganj to meet the growing demand and a considerable increase in the output of truck and bus tyres, cycle tyres, cycle rims, industrial rubber products and Dunlopillo is planned.

Twenty-one years after the founding of India's first tyre factory, Dunlop are putting up another at Ambattur near Madras which is expected to go into production by the end of 1958. Truck, bus and cycle tyres will be produced here primarily for the needs of the South Indian market.

SHRI KARNAIL SINGH VISITS INTEGRAL COACH FACTORY

Shri Karnail Singh, Member, Engineering, Railway Board, New Delhi, recently inspected the Integral Coach Factory, Perambur. His visit also coincided with the ceremony of the inauguration of the sixth and lost assembly line scheduled to go into production in the Main Assembly Shop on January 9th.

Regretting at the outset that he could not address the gathering in Tamil, Shri Karnail Singh said that the making of Integral Coaches in India was a fine achievement. But, he added, even greater than this achievement was the acquisition of confidence of the workers of I. C. F. that they can "fashion metal sheets into anything that is required." He congratulated all the workers and the officers from whom they had received direction for their fine work at Perambur.

After seeing the fine workshop at Perambur, Shri Karnail Singh said, it was a great pleasure to see the "inner happiness and the brightness so far as the human part of it is concerned." And in so far as the work part is concerned, I can see in the hands and the eyes of the workmen at the machines, the confidence, with which you all are either handling the electrodes or pressing sheets through straightening machines or doing any other type of work.

Earlier Shri K. Sadagopan, Chief Administrative Officer, in his introductory speech said it was a great honour to welcome Shri Karnail Singh whose "dynamic ability, leadership and personality" was reflected in the attainment of the most impressive production record of locomotives at the Chittaranjan Locomotive Works—when Shri Karnail Singh took charge of it.

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JAPANESE RAIL ENGINES—INDIA PLACES ORDER

The Railway Board have placed an order for 10 broad-gauge electric A. C. type locomotives with a firm of rolling stock manufacturers in Japan.

A feature of the contract is that deferred payment terms have been agreed upon by the firm concerned.

The total value of the order is in the neighbourhood of Rs. 98 lakhs.

The Railway Board have also placed an order with another Japanese firm for the supply of spare parts for metre-gauge rail cars, which are already in service.

IN YOUR OWN INTERESTS

HOW TO PURCHASE TICKETS

Buy your tickets only at the proper place. The authorised offices are (i) the Booking offices at the railway stations, (ii) the Town or City Booking Offices, (iii) the out-Agencies, (iv) Travel Agent. Never buy tickets from any other source as that may lead you to trouble. Please note that tickets are not transferable.

Buy your tickets in the proper time. You can avoid unnecessary excitement and trouble if you come to the station in good time, that is at least half an hour before the scheduled departure of your train. The Time Tables of the Railway are on sale at Booking Offices and Bookstalls.

Buy your tickets in the proper manner. Queue up at the Booking Window and you can get your ticket easier and quicker than by crowding at the counter.

By handing in the *exact fare in good coins or currency* you get the ticket easier and quicker, and save for yourself and the Booking Clerk time and trouble.

Check up your ticket and money before leaving the counter and draw the attention of the Booking Clerk to any discrepancy you may notice.

(Inserted in the interests of Travelling Public)

SOUTHERN RAILWAYS MAGAZINE

INDUSTRIAL MYSORE SUPPLEMENT

CONTENTS

Editorial Notice

The Editor invites contributions to the Magazine on a variety of topics — short stories, technical features written in simple English understandable to the laymen, Aspects of Railway Working, places of tourist interest, News from home line, activities on Railway Institutes etc. All copy should be brief and typed as far as possible.

Photographs illustrating social functions, sports events, scenic sports etc. are also invited. All contributions should reach the Editor not later than 5th of each month. Rejected Mss. will be returned provided sufficient stamps for postage are enclosed. No responsibility will be borne for copy lost in transit.

Views expressed in this Magazine should not be taken as having official authority.

All correspondence should be addressed to the Editor, "Southern Railways Magazine," Post Box No. 17, Tanjore, (South India).

A Short History of Mysore Lamps

THE Company was floated in 1936 and the manufacture started in the following year. All types of Electric Lamps in general service from 5 to 1500 Watts, Floodlight Lamps of 500 and 1000 watts, Street Series Lamps of 400 to 4000 lumens, Torch and Bicycle Lamps, Train Lighting Lamps, Decorative Lamps, Telephone Switch Board Lamps etc. are manufactured by the Company. The manufacture of Fluorescent Lamps is also under consideration.

The products are well received by the Governments and the General Public. The full requirements of the Mysore Government in Electric lamps, including the Street Series Lamps, are being met by this Factory.

We are also on the rate contract of the Government of India for supply of general service lamps to all Government Departments and for supply of Train Lighting Lamps to Railways.

It has installed highly automatic up-to-date machinery with a capacity of 16,000 lamps per day and is managed by well-trained, skilled personnel. At present the daily production is about 10,000 lamps per day. The demand is rising and production is being stepped up. The efficiency and long life of Mysore lamps are well known and there is great demand for these lamps all over India.

The Company has been awarded Gold and Silver Medals in several Exhibitions and fairs for quality and brightness of the electric lamps.

As a member of the Indian Lamp Factories Association, the Company, strictly adheres to the price policy of the Association.

The Company is being managed by the Board of Directors with the Chief Engineer (Electricity) Government of Mysore, as Chairman.

Agents have been appointed all over India to cater to the needs of the Public and various industries.

The Mysore Chrome Tanning Company

ORIGINALLY started in 1908 as The Mysore Tannery for Chrome Tanning of Cow hides, the Company passed through vicissitudes and changed many hands and finally in the year 1940 under the patronage of Government of Mysore, it was converted into a Public Limited Company on a joint stock basis with a Share Capital of Rs. 5 Lakhs and subsequently raised to Rs. 10,00,000/- and the new company took the present name The Mysore Chrome Tanning Co., Ltd. The Government of Mysore have subscribed 26% of its share Capital. The paid up Capital is Rs. 4,94,452—8—0.

The Management is vested in a very influential Board of Directors, three of whom are Government nominees, one of whom is Additional Director of Industries & Commerce, Government of Mysore, Ex-Officio Chairman & Managing Director.

The Company manufactures all kinds of Chrome Upper leathers, B. T. Soles for footwear, and leather articles such as Suit Cases, Document Cases, Tappal Bags, Jewel Cases, Industrial Leathers, Washers etc., etc. Its leathers are well known in the markets of India, Ceylon, Singapore, U. K. etc. The maximum manufacturing capacity is 1,00,000 sq. ft. per month, but at present it manufactures only 30,000 to 40,000 sq. ft. per month owing to scarcity of good Chrome quality hides, and other drawbacks.

The Company has now commenced manufacturing Textile Leathers also for which there is a good future.

IRON & STEEL PERMITS FOR AFGHANISTAN

A limited quantity of controlled items of iron and steel will be allowed to be exported to Afghanistan by the approved importers of fruits and asafoetida who have effected imports of the goods from Afghanistan, according to a notice issued by the Iron and Steel Controller of the Government of India. Permits will be issued to importers on ' first come first served ' basis.

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INDIA'S IRON ORE EXPORT TO JAPAN

An official Indian delegation led by Mr. D. Sandilya, Joint Secretary, Ministry of Commerce and Industry and Managing Director of the State Trading Corporation, left New Delhi for Tokyo for discussions with the representatives of the Japanese steel industry on the supply of Indian Iron ore during 1958—59.

During the discussions the prices for the supplies to be made in 1958—59 as well as the schedule of deliveries and shipments will be finalised.

Under a five-year agreement entered into between the Corporation and the Japanese steel industry, the Corporation has undertaken to export 7.2 million tons of iron ore to Japan during the period April 1957 to March 1962. The contract for the first year, i. e. 1957—58, was for a total quantity of 1.3 million tons, whereas during the present year the supplies will amount to 1.4 million tons.

Last year, out of India's total exports of about Rs. 27.2 crores to Japan, exports of iron ore accounted for slightly over Rs. 7 crores.

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INDIA'S COAL TARGET

It is learnt that India's target for coal production in the Third Plan period has been tentatively fixed at 100 million tons. As far as coal production in the public sector in the Second Plan period is concerned, the Planning Commission has placed a ceiling of Rs. 40 crores for investment as against Rs. 45 crores suggested by the Ministry of Fuel. The proposal to permit the private sector to produce, during the Second Plan period, an additional 1.4 million tons of coal to serve as a cushion against any possible shortfall in that sector has, however, been dropped.

The Planning Commission has also finally reduced the original provision of Rs. 60.6 crores for the integrated lignite project at Neiveli to Rs. 46.6 crores made up of Rs. 20.3 crores for the mining scheme, Rs. 17.0 crores for the thermal power station and Rs. 9.3 crores for the fertilizer plant. The briquetting and carbonisation scheme of the Neiveli Project is dropped for the present.

Gold Thread Industry in Mysore

THE Industry of Gold Thread can be classed as a part of Sericulture Industry as the manufacturing of Gold thread whatever may be the quality, involves use of pure silk yarn. This Industry is mostly confined to the state of Bombay-Surat being the main centre and Varanasi once a thriving manufacturing place.

The Gold thread manufacture was at first sponsored by a French Concern M/s. C. Dutel & Co. Bangalore. The Mysore Gold thread company Ltd., Bangalore was the firm so started during the year 1932. M/s. Parry & Co., Madras were their Managing Agents. The said Company had a difficult period owing to very keen competition from Surat. It had at last to hand over to Sri S. Dhondusa, Mamulpet, Bangalore, a veteran Gold thread merchant who had vast experience in the Gold thread trade and already representing a German Company—The LEONISCHE DRAHTWERKE A-G—Nurnberg as Sole Agent for South India.

The said Sri Dhondusa could not by oversight change the fortune of the Industry. He had to face the keen competition both local as well as Foreign. The World War 1939 was a turning point. Imports were banned and Indian weavers had to go in for Swadeshi goods. The quality of Gold thread was improved to suit the requirements of the weavers. The factory added on their own 'SILK TWISTING PLANT' and the 'DYEING SECTION'. These minimised the cost of production. Today the products of 'S. Dhondusa Gold Thread Factory' are popular and well known for their Superiority. Quality control is introduced and this has helped a good deal for manufacturing the standard of Gold Lace. The Government of Mysore and other State Governments and number of established weaving factories are encouraging the firm. There is still a good scope for expansion as the demand when compared for the present production is very high.

PNEUMATIC SPOT WELDING MACHINE

Aston Electrical Products Pty. Ltd. at East Sydney (Australia) have produced a new pneumatic spot welding machine to meet the needs of the light gauge metal and wire working shops, using spot welding technique for metal fabrication. It is regarded as particularly suitable for the assembly of small articles manufactured for the domestic hardware and office equipment trades.

The operation of the new machine is automatic. The operator has only to press the pneumatic foot valve for each spot weld. This eliminates fatigue associated with manually operated machines and ensures a greater output of fabricated components.

Controls for the machines are conveniently placed for easy accessibility and adjustment. Welding pressure can be applied by means of an air-pressure reducing valve, a pressure gauge indicating the air-pressure applied to the operating cylinder. This means that correct welding pressure can be easily adjusted within seconds compared with the manual machine, which usually requires spring adjustment at the rear.

" Squeeze " time, the period during which pressure is applied to the weldments, is regulated by adjusting the pressure switch, mounted adjacent to the head. " Weld " time, the period during which welding current flows, is controlled electronically by a plug-in Thyratron Timing Unit.

Welding heat-taps have been provided to give a welding range from two pieces of 28 S. W. G. clean mild steel sheet to two pieces of 16 S. W. G. clean mild steel sheet on continuous production, or two pieces of 12 S. W. G. clean mild sheet intermittently, and wire work from 18 S. W. G. to 4 S. W. G.

The four controls provided i. e. " Pressure ", " Squeeze " time, " Welding " time and " Welding Current ", make the machine suitable for operation by unskilled process labour, as once set up correctly, weld quality will not vary.

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PROCESSING OF SCRAP

In an 8 hour shift, a model 3,000 Harris baling press processes over 350 tons of scrap. For feeding the press, a mill-type overhead crane is equipped with a 65-inch, 8-coil electro-magnet and an orange-peel bucket. Matching the operating cycle of the press, the crane handles unloading, feeding of the press, and reloading the finished bundles into railroad cars.

The baling unit can reduce 3 automobiles to a bundle of scrap 60 × 60 × 24 inches in 90 seconds. Since bundles of this size are too large for the charging doors of most steel mills, normal bundles contain only 1 automobile.

Mysore Machinery Manufacturers

A large scale Engineering Industry in Mysore with its Factory and Office located at Mile 5, Mysore Road, Bangalore. The Company was established in the year 1946, under the former Mysore Companies Act as a Public Company. This Company is engaged in the manufacture of Textile Machinery i. e. Looms and Dobbies, besides manufacture of Steel Structures and Water Tanks. The factory also undertakes orders for supply of Grey Iron Castings and Engineering Job works.

The Factory has a fairly well equipped Foundry and workshop and has a strength of nearly 500 employees. The Mysore Looms made in this factory are installed in large Mills as well as small power loom units and are adapted for weaving Cotton as well as silk and art silk fabric. A large number of these looms are installed in Bangalore, Doddaballapur, Salem and other power loom centres of the South besides Big Mills in Bombay and upnorth.

The Chief raw-materials required by this Industry are Iron & Steel and are obtained from the Mysore Iron & Steel Works Bhadravati and other indigenous sources. A few components are met out of Imports. The factory is worked by electric power supplied by the Mysore Government source.

The Company is managed by the Managing Agents Messrs. The Industrial Agents (Private) Ltd., subject to the control of the Board of Directors. The Company contemplates expansion of the Ferrous castings section and has a proposal to manufacture Malleable Iron, Castings largely required by Indian Railways and other heavy industries.

CHITTARANJAN LOCOMOTIVE WORKS

Chittaranjan Locomotive Works which started production in January 1950 has been progressing rapidly, and upto March this year, 663 locomotives have been manufactured and put into service on Indian Railways.

The Factory, which turned out 77 locomotives before the First Plan started was expected to go into full production by 1957 and turn out 120 BG locomotives and 50 spare boilers a year. But it achieved the target of 120 average-sized locomotives by March 1951.

During 1957-58, 164 locomotives were manufactured. Production has progressed considerably from 12 per month in April 1956 to 14 per month in August 1956. The improved performance was achieved by partial night shift working and the import of some components for balancing the production of the various units.

With the fabrication of bar frames from Tata slabs inside the works, procurement of angle and dome rings from the Tatas and certain steel castings from domestic manufacturers, and the production of certain loco fittings by the works itself, it has been possible for Chittaranjan to eliminate certain imports much earlier that expected.

During 1956-57, the factory produced 120 locomotive boilers which have been fitted to the locomotives produced here. Since the commencement of boiler production the factory has turned out 338 WG boilers upto the end of March 1957, when the production rate reached 12 locomotive boilers a month.

It has been decided to suitably expand the works for the stabilisation of an annual production of 300 average-size locomotives a year by the end of the Second Plan. The expansion is estimated to cost about Rs. 5 crores. A scheme has also been finalised for establishing a steel foundry here with assistance from the Technical Co-operation Mission.

With three new steel plants going into production soon and with the proposed steel foundry, dependence in respect of certain imported raw materials will cease and it would then be possible for the Works to be entirely self-sufficient in regard to imported items.

Total expenditure on the project till the end of 1957-58 is estimated at Rs. 14.6 crores of which about 50 per cent has gone for the housing colony and amenities for the workers.

The Bangalore Woollen, Cotton & Silk Mills

THESE Mills, situated in Bangalore and managed by Binny & Co. (Madras) Ltd., remain almost unique in the cloth industry producing from the raw materials finished Cotton, Woollen and Silk products.

WOOL, the warmest of all raw materials, is obtained, as you know, from sheep. Unfortunately the wool of the Indian sheep is generally short in staple and coarse in texture, and though used for several of the Mills' coarser types of Woollen products, it is not suitable for spinning fine yarns. The Company's production of fine woollen goods, when the most careful attention is paid to turning out the best possible article, is therefore dependent on imported raw materials. Amongst the wide variety of the Woollen goods produced by the Company's Woollen Mill situated at Hebbal, are Rugs, Shawls, mixture cloths and Worsted materials.

One of the Mills' more recent cloths, which is quickly increasing in popularity, is *Cotswol*. This cloth is a blend of high quality cotton and wool. It is neither too warm nor too cool, having a special quality which permits it to air the skin, thereby allowing the body to maintain a constant comfortable temperature. Being much cheaper than an all wool product, this cloth is just the answer to fill the gap in a public need for a cheap woollen material.

The yellow flower of the *COTTON* plant is a familiar sight in South India, and it is from this flower that the majority of the most suitable clothing for this climate originates.

From these flowers come the fibres, which have to be separated from their black and brownish seeds. Once in the Mill these fibres are beaten, cleaned, sorted and blended. This takes place over a course of fascinating mechanical processes until after 'Carding' one is left with the 'sliver', a rope like form composed of fibres now devoid of all impurities.

The 'sliver' is then further processed, depending on the type of cotton used, until it has been suitably drawn out, the fibres paralleled and slightly twisted before being spun into yarn in the Spinning Department.

The weft yarn is transferred from the bobbins on which it has been spun, to the pirns on which it is carried in the shuttle for weaving. Warp yarn is wound from the spinning bobbins into larger and more convenient packages, and from these packages it is again wound on to large beams. The yarn from these beams, which is now in the form of a sheet, is passed through the sizing machines where starch is applied to it to strengthen it for the considerable stresses and strains to which it will be subjected during weaving. As they leave the sizing machine, the sheets of yarn from several warpers' beams are wound on to a weaver's beam, in which state it is taken to the loom.

Binny Mills are one of the few in India mainly equipped with automatic looms, and it is the high standard of yarns which these looms require which is the buyers' guarantee of the durability of the Mill's finished cloths.

SILK, that soft, lustrous, beautiful, durable and most gracious of fabrics is yet another product of the Mill.

This fabric with its humble beginnings in cocoon form, is drawn, reeled and woven into something, a finished material of very real beauty and splendour. Mysore, the home of the Indian silk worm may well be a proud state, claiming to clothe the most elegant of this country's women.

Silk produced in Mysore is as strong as foreign silk and rather yellow, but it is not cultivated as scientifically as in the major silk-producing countries. The consequence is that Mysore filature is uneven and hairy. This fault, however, could be overcome if all concerned in the growing and reeling of silk work determinedly to improve quality and production.

Unless this is done the products of the State's silk industry will continue to be unable to compete with foreign silk in quality and price in export markets.

Started in 1877 as a small business in Bangalore Cantonment, the Company has grown and flourished. Almost 8,000 people are now employed, and the Company's "Sheep" Trade Mark has become the guarantee of quality to both distributor and consumer.

RAIL EXPERTS LEAVE FOR JAPAN

An additional member of the Railway Board and two senior officers left for Japan on 11th May 1958 at the invitation of the President of the Japanese National Railways.

They are Shri E. V. Isaacs, Additional Member of the Railway Board in charge of Mechanical engineering, Shri S.S.Mukherjee, Deputy Chief Engineer, South Eastern Railway, and Shri G. P. Warrier, Deputy Chief Engineer, Southern Railway.

These officers have been invited to promote and develop closer relations between the Indian Railways and the Japanese National Railways and also for discussions regarding the modernisation of the railways, particularly in regard to A. C. current railway electrification.

The visit would also provide the officers with an opportunity for acquainting themselves with railway facilities and related industries in Japan.

They will also visit a special exhibition of railway equipment and machinery which is being held in Japan.

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AIR-CONDITIONED EXPRESS TRAINS

The air-conditioned vestibuled trains providing chair-car accommodation in third class between New Delhi and Madras Central, New Delhi and Bombay Central and New Delhi and Howrah will in future be known as "air-conditioned express trains", according to a decision taken by the Railway Board.

In Hindi, the trains will be designated as "Vatankul Express Gadi".

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NEW RAIL LINK WITH KANDLA—SERVICE INAUGURATED

A new link between the Kandla and the States of Rajasthan and Punjab was opened with the inauguration of passenger traffic on the Bhildi-Raniwara section of the Northern Railway.

The 44 mile long stretch was completed by the Western Railway at a cost of Rs. 1.60 crores.

Shri B. L. Rawat, Commissioner for the Jodhpur Division, inaugurated the through passenger traffic.

Hundreds of people, including women greeted the train as it passed through various stations on the route.

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SLEEPERS FROM KASHMIR

Kashmir State would supply 4.15 lakh sleepers to the Railway during the period January 1958, to October 1959. An agreement to that effect had been reached with a view to stepping up the off-take of timber from the State. Shri S. V. Ramaswamy, Deputy Minister for Railways, informed Shri Indulal Yajnik. He added that owing to frequent floods in the Kashmir Valley resulting in lakhs of cubic feet of timber being washed away to Pakistan, there had been a reduction in the supply of timber sleepers from Kashmir during the past two years.

Shri Ramaswamy informed Shri Heda that India was importing timber from abroad. But during the past few years there had been reduction in imports also because of the deteriorating situation in the Eastern countries.

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MICA PAPERS

A new material called "mica paper" and made with industrial scrap mica, which can be used with excellent results as an insulator in high temperature capacitors for supersonic aircraft, guided missiles and satellites, has been reported to the Electronic Components Conference in London.

The material, which was developed as a replacement for virgin mica, is said to have performed as well as for better than natural mica as a capacitor dielectric in extensive tests. Mica paper is also reported to have added advantages of lower cost and easier handling characteristics in manufacturing than natural mica.

BHARAT ELECTRONICS

BHARAT Electronics (Private) Limited was established by the Government of India as a Private Limited Company in April, 1954 with an authorised capital of 10 crores including the working capital of 2.5 crores. The company was started with the object of making India self-sufficient in electronic communication equipment and radar. The company is under an agreement with Messrs. Compagnie Generale de Telegraphie Sans Fil of Paris for Technical assistance for a period of ten years.

The factory is situated in Jalahalli near Bangalore, well served by water and electricity.

Construction of the factory building was taken up in May, 1954 and completed by the middle of 1956. The buildings have a floor area of over 500,000 sq. ft.

One of the departments to start functioning early was the Technical Training Centre where several batches of tradesman have been trained.

The factory went into production with the manufacture of tools for the first communication receiver in 1956. The present production programme includes General Purpose Communication Receiver, a Medium wave 400 Watt Transmitter, various types of VHF Trans-receivers a small Rawin Transmitter for the Indian Meteorological Department and different types of Consoles for All India Radio.

BOARD OF DIRECTORS

1. Shri O. Pulla Reddy, ICS, Chairman.
   Secretary, Ministry of Defence.
2. Shri S. Jayasankar
3. Dr. M. B. Sarwate
4. Shri Vithal M. Chandavarkar
5. Shri S. M. Ramakrishna Rao
6. Maj. Gen. S. D. Verma
7. Dr. K. S. Krishnan
8. Shri A. K. Ghosh, ICS (Managing Director)

COPPER CONDUCTORS FOR OVERHEAD POWER TRANSMISSION

Copper conductors are being increasingly used in the country for general and rural electrification and indigenous production of these has steadily been increasing. To ensure that the indigenous production of these conductors conforms to all the requirements laid down in the relevant Indian Standard, the Indian Standards Institution has granted, under the ISI Certification Marks Act, 1952 one more licence to the National Screw and Wire Products Ltd., 51 Stephen House, 4 Dalhousie Square, East, Calcutta-1 for the use of ISI Standard Mark in respect of hard-drawn copper solid and standard circular conductors for overhead power transmission purposes, conforming to Indian Standard No. IS : 282—1951. Four licences in respect of hard drawn copper conductors are already in force and this is the fifth licence.

The Standard Mark consists of a monogram of the ISI with the number of the Indian Standard (282) superscribed on the top side.

With the grant of this licence the Institution has covered a major portion of the indigenous production of conductors. Any complaint regarding the quality of the certified products may be brought to the notice of the licensee, as well as the Institution.

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MANUFACTURE OF SPECIAL STEELS

Sardar Swaran Singh, Central Minister for Steel, Mines and Fuel, has announced that plans are in a "fairly advanced stage" for the manufacture of tool, alloy and special steels, and that "we shall be ready to proceed within a few months on the project."

The Minister, who was presiding over the annual general meeting of the Steel Rolling Mills Association of India, has added that "unless we go ahead with this fairly quickly, we shall be depending, even at the end of the Plan, on imports for these steels. It would be wrong to import something that we can make ourselves. The progress of the plants has been so far satisfactory. There have been some delays here and there, but these delays have been inevitable and are insignificant in relation to the size of the problems we have encountered."

GOLDEN RULES OF CONDUCT FOR RAILWAYMEN

1. Do you plan your work daily? Get the more essential things done first and do not neglect the important ones sidetracting them to the fag end of the day.

2. Do not express casually careless opinion. Never venture forth an opinion unless asked for it.

3. Remember that most of our mental worries come either from trying to fight life hard or from trying to run away from life. Do neither.

4. Learn to accept people as they are, Love them, respect them, praise them, encourage them, differ with them, but above all, learn the priceless art of give and take.

5. Cry neither for the moon, nor over spilt milk.

6. Accept the things that you cannot change; have the courage to change the things that you can, and possess the wisdom to know the difference.

7. Do not drive too hard a bargain with yourself.

8. Accept life as it is — its wonders, changes, disappointments, frustrations etc., etc.

Government Electric Factory

THE Government Electric Factory was started in the year 1934 for the manufacture of Bakelite articles with a labour strength of 200. Shortly thereafter, manufacture of Transformers which was being carried out earlier in the Electricity Department of the Government of Mysore was shifted to this factory and a regular section for the same was formed. Gradually, other lines of manufacture like the manufacture of Surveying Instruments, Transmission Towers, Line Materials etc., were also added on. At present the factory is employing about 1,000 workers.

The progress of the factory has been phenomenal during the last 4 to 5 years during the course of which the turnover has considerably increased. The production of Transformers which was of the order of 33,000 KVA during the year 1943—44 rose to about 60,000 KVA during 1955—56 and 90,000 KVA during 1956—57 and it reached 110,000 KVA during 1957—58. Likewise, the average turnover which was of the order of about Rs. 15,00,000/- upto 1948—49 rose to Rs. 42,00,000/- in the year 1955—56 and touched the figure of Rs. 67,00,000/- during 1956—57 and the same is likely to be achieved during 1957—58.

Further expansion of Transformers, Motors and Switchgear manufacture in collaboration with AEG of West Germany is under active consideration of Government. The Scheme contemplates stepping up of production of Transformers to an aggregate of 200,000 KVA per year per shift taking the largest size to 10,000 KVA on 66,000 vs. voltage rating. Besides the manufacture of Motors is also contemplated to produce Motors to an aggregate of 60,000 H. P. per annum per shift, the largest size of the Motor to be produced being 250 H. P. The Scheme also provides for the manufacture of Switchgear and Switch Boards of various capacities and voltage ratings, the highest of all being capable of handling 600 Amps. current on the 11,000 vs. line voltage.

The present strength of the factory which is about 1,000 is expected to be increased by another 500 to 750 employees when the Scheme is implemented.

The factory is meeting the demands of Transformers required by the Electricity Department, Government of Mysore and also of various other States and Private Electricity Undertakings in the Country.

Rail Concessions to Blind, T.B. and Cancer Patients—Procedure for Availing of Concession

Some misunderstanding still appears to exist about the procedure for availing of the rail concessions announced by Government some time ago for blind persons and persons suffering from T.B. and Cancer.

Government wish to re-emphasize that in the case of blind persons the concession is admissible for all their journeys. For availing of the concession, blind persons need only produce a certificate from a registered medical practitioner or the head of a recognised institution for the blind or attested copy of the same together with the originals for inspection at the station booking office. The concession will be granted on the authority of this certificate.

In the case of patients suffering from tuberculosis and cancer, rail concessions are available only for journeys undertaken for admission to, or on discharge from, a recognised hospital, sanatorium, or institute. The concession is not admissible to them for journeys in connection with their periodical check up. For availing of the concession, the patients should first obtain the requisite certificate from the officer in charge of the hospital, sanatorium or institute. Cancer patients seeking admission in a hospital or institute may obtain a certificate from a district medical officer also. The medical certificate should be produced before the authorised railway officers who will then issue necessary letters of authorisation (concession orders) on the stations from where the journey is to commence. Only presentation of these concession orders will the tickets at concessional rates be issued.

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STUDENT CONCESSION SEASON TICKETS—
AGE LIMIT NOT TO APPLY TO FEMALES

The Railway Board has decided that the age limit of 25 years imposed for the grant of concessional season tickets to students on the Indian railways will not apply in the case of female students.

CANARA BANK'S PROGRESS

HIGHER EARNINGS

THE 52nd Annual Report of the Directors of the Canara Bank Ltd., for the year ended December 31, 1957 shows a sum of Rs. 11,67,267 as available for distribution against Rs. 8,41,002 during the previous year. Out of this sum Rs. 7,30,000 has been provided for income tax, Rs. 52,500 for payment of preference dividend, Rs. 1,50,000 for dividend to equity-share holders at 10 per cent and Rs. 1,90,000 for payment of bonus to staff. The balance of Rs. 44, 767 is carried forward to the next year.

That the bank's financial position is comfortable can be seen from the fact that advances constituted 49 per cent of the deposits against 52.3 per cent, during the previous year. This, it is interesting to note, has not greatly affected the earnings of the Bank, which are higher than the previous year. The Profit & Loss Account shows, on the income side, an increase in earnings from interest and discount from Rs. 49,54,430 to Rs. 62,06,233. On the expenditure side, interest paid on deposits and borrowing also has increased from Rs. 26,72,825 to Rs. 37,34,219.

The Bank is steadily expanding its activities and in the new State of Mysore, is playing a major role in the provision of credit in rural centres. The year under review witnessed the opening of nine new branches, at Mazagaon & Dadar in Bombay city, at Ulhasnagar in Thana District, at Warangal in Andhra, at Mercara, Tumkur, Gulbarga and Hampankatta (Mangalore) in Mysore State. The Bank proposes to open many more branches during the year. The Bank has always been a source of strength to Government of Mysore in the successful execution of its borrowing programme as can be seen from the fact that last year, a substantial portion of the Rs. 3-Crore Mysore Loan was subscribed by the Canara Bank. Canara Bank can be expected to play a greater role in Mysore's economic development in the years ahead.

METAL TUBE PLANT IN INDIA

It is understood that a Bombay firm proposes to establish a factory for the production of non-ferrous metal tubes. The necessary licence has already been obtained, and negotiations are under way for the purchase of the main press and auxiliary machines for the extrusion plant.

Although the cost of the plant is estimated to be Rs. 12.50 lakhs, the company has been granted an import licence for only Rs. 4.5 lakhs. The promoters, Devidayal (Sales) Private Ltd., have, therefore, approached American and Indian financial institutions for loans to purchase machinery. The demand for non-ferrous tubes in the country is estimated at about 1,800 tons per annum and is expected to go up to 2,700 tons by 1961—62. Cables, for instance, used 8,644 tons in May against 7,899 in April, while off-take for sheet and pipe manufacture rose to 5,648 tons from 5,194 tons. Among declines were batteries, which fell to 2,466 tons from 2,561 tons in April. U. K. exports and re-exports of pig lead in May fell to 1,190 tons from 1,666 tons in April. Those to the U. S. were sharply lower at 150 tons compared with 726 tons in April, while the Union of South-Africa also took considerably less in May at 76 tons against 250 in April. Stocks of refined lead in the U. K. continued to decline in May to stand at 34,608 tons compared with 37,509 tons a month earlier.

Consumption of zinc (in all forms) in the U. K. during May fell slightly to 24,579 tons from 24,984 tons in April. Exports and re-exports of slab zinc in May amounted to only 111 tons compared with 192 tons in April while U. K. stocks of slab zinc at the end of May totalled 50,539 tons against 47,251 tons a month earlier.

Refined tin usage in May 1,533 tons compared with 1,725 tons in April with off-take by the tinplaters lower at 778 tons against 915 tons in April. Exports and re-exports in May amounted to 924 tons compared with 821. Consumption of cadmium in May was 79.40 tons compared with 80.00 tons in April. There were no exports and re-exports during May whereas one ton was sent overseas the previous month. Stocks of cadmium at the end of May amounted to 231.82 tons against 227.88 tons at the end of April.

INDIA'S AVIATION INDUSTRY or the story of HINDUSTAN AIRCRAFT (PRIVATE) LTD., BANGALORE

INTRODUCTION

THE Second World War gave a great impetus to the advance of technology. And it may be stated, with some authority, that a large share of man's technical effort since, has been devoted more to aviation than to any other single branch of human endeavour. This has been generally true of the industrially advanced west, and in a lesser degree, of an underdeveloped country like India. In common with the rest of world, India seized the opportunity provided by the war. To sustain the war effort and to meet the demands of internal economy, India was compelled to make the maximum use of her internal resources, indigenous skill and enterprise. It was at once an opportunity and a challenge to our industrialists, and they were not slow to respond to the call. Among them was that great industrialist, Seth Walchand Hirachand, who had the foresight and acumen to visualise India as a centre of aviation industry and to lay its foundation. To Bangalore was given the distinction of being the home of the first Aircraft Industry in the East and Hindustan Aircraft Ltd., was established by him on the 24th December 1940 in collaboration with the Government of Mysore. Mr. W. D. Pawley of the Inter Continent Corporation, the well-known American leader in Aircraft Industry, was entrusted with the construction of the plant in Bangalore, and thereby an era of Indo-American co-operation was inaugurated.

HISTORY

Part 1—1940—46.

Shortly after the establishment of the factory, the Government of India became a member of the Company, and a year later the factory was taken over by them completely, so far as the private holdings were concerned. The only two present members are the Government of India and the Government of Mysore. The authorised capital of the Company is Rs. 18 crores. Of the paid up capital of about Rs. 6 crores, the major portion is held by the Government of India.

The original programme of the factory was the manufacture of Curtiss Hawk Fighters, Vultee Bombers, Harlow Trainers and Allied equipment.

Barely eight months after the inception of the factory, the first aircraft was assembled and flown. And an year later, the first Curtiss Hawk P—36, a single seater fighter monoplane was completed and test flown. Almost at the same time, the first ten-seater Glider, locally designed, was built and test flown, marking a land-mark in Indian aviation. Meanwhile more planes, Hawk P—36 and Harlow PC—5, started coming off the production line. Orders continued to pour in. The U. S. Army Air Force Placed an indent for the mass production of Belly Fuel Tanks for the combat aircraft operating with the allied Air Forces. The factory began to expand with the addition of new equipment, machinery and more men to cope with the increasing programme of work. With this expansion, the factory became the Major Maintenance Base for the Far East with the designation, 84th Air Depot of the United States Army Air Force, for the overhaul of Heavy and Light Bombers, Fighters and Catalina Flying Boats etc.

In 1943 with the war in South East Asia in full swing, the U. S. Army Air Force, faced with colossal aircraft repair and overhaul requirements took over the Management of HAL from the Government for the duration of the war. All aircraft manufacturing programmes were suspended and the factory began to work round the clock in three shifts. The man power strength of the factory reached the figure of 15,000. A separate engine and overhaul department was formed with the target, in due course, to overhaul 300 Aero Engines a month.

As the war against Japan intensified in 1944,

HAL's contribution and importance became enormous and its work elicited the appreciation of the Commander-in-Chief, Allied Air Forces, South East Asia.

With the termination of the war in 1945, the management of HAL reverted to the Government of India. Some idea of the immense contribution made by HAL to the war effort can be gained by the following overhaul figures during the Management of the Factory by the American Army :—

1.	C—47	Cargo Planes	406.
2.	B—25	Light Bombers	374.
3.	B—24	Heavy Bombers	176.
4.		Catalinas	55.
5.		Miscellaneous Aircraft	160.
6.		Aircraft Engines	3,800.

With the end of the war and the consequent curtailment of its activities there was heavy retrenchment in personnel and the future of HAL itself was uncertain.

However, this uncertainty was dissipated by the recommendations of the Aircraft Technical Mission from the U. K. which visited India at the initiative of the Government of India in 1946. In the context of the already existing equipment and facilities, the Mission had no hesitation in recommending that HAL should become the nucleus for the development of aircraft manufacture in India.

Part 2—1946—1953.

With its future decided, HAL began to forge ahead. The first step taken was the formation of a Sales Department and HAL started operations as a commercial undertaking. To start with, an order from the Indian Air Force was received for the repair and erection of 100 Tiger Moth aircraft.

The following year, the year of India's Independence, HAL was recognized at the authorised Douglas Service Centre in India. More orders were received from the I. A. F., this time, for the overhaul of Dakotas and later for the manufacture of Percival Prentice Trainer Aircraft.

At the same time a full fledged Engineering and Design Department was formed at HAL with the appointment of Dr. Ghatage as Chief Designer, who set about organising the Department in right earnest.

The following year, (1948) constituted another landmark in the development of the factory when it took in hand the designing of its own Trainer aircraft, designated H. T.—2. And the following year, the first Indian built Percival Prentice was test flown while H. T.—2 wooden mock-up was completed. In the same year HAL, in addition to installing a pressurised cabin in a Dakota for the use of the Deputy Prime Minister, the late Sardar Vallabhai Patel, converted two I. A. F. Dakotas as Flying Navigational Class Rooms. Another item of work undertaken by HAL for the I. A. F. was the modification of a Dakota as a Target Towing Aircraft for gunnery practice.

In 1950, HAL was admitted as a Member of the Society of British Aircraft Constructors. This year marked another stage in its expansion with the inauguration of the Apprentice Training Scheme to cater to the increasing requirements of technical and skilled labour to man the different sections in the factory. At the same time HAL placed its facilities at the disposal of the I. A. F. for short term training of their technicians.

1951 marked another notable step forward in the development of the industry with the building and erection of Jet Fighter Aircraft entrusted to it by the I. A. F.,—A technical Liaison Staff from De Havillands was posted at HAL to co-ordinate its jet aircraft production. The first jet aircraft was assembled and test flown in March of that year by Capt. Munshi. The first HT—2 prototype made its first public demonstration in August. At the same time the mock-up of an advanced trainer aircraft was also undertaken; while the Prentice programme entered a new stage—being built from HAL manufactured jigs and tools.

On the side of training, a 'Training within Industry' scheme, under the auspices of the

International Labour Organization was introduced at the upper level of Management with the intention ultimately to extend it to all supervisory personnel. Also Engineering Designers and technicians were deputed to the U. K. to familiarise themselves with the latest production methods in use in U. K. factories.

In 1952 the second prototype of the HT—2 was test flown. More and more special conversion of Dakotas for the I. A. F. were undertaken while Aerial Survey Camera modifications were carried out in one Liberator and three Dakota aircraft.

Part 3—1953 and onwards.

1953 may rightly be described as the year of the H. T.—2. The First Type Certificate in India was presented to H. T.—2 by the Director General of Civil Aviation. Six H. T.—2s flew past before the President of India in New Delhi on 26th January 1953, India's Republic Day. An HT—2 went overseas for the first time to participate in the Ceylon Air Rally in August that year.

The year also marked the completion of the manufacture and delivery of Percival Prentice Aircraft to the I. A. F. The first amphibian aircraft was received from the Navy for repair, while ten Dakotas were overhauled and converted in record time to enable the commencement of the air lift of Haj piligrims by Indamer Company, Bombay.

Also the first *Jet fighter manufactured by HAL* was successfully test flown and delivered to the I. A. F. HAL now was awarded the Service Station Certificate for American aircraft by the U. S. Civil Aeronautics Administration and thereby became the first organisation in Asia to achieve this distinction.

During the period 1955—57 HAL turned its attention overseas with a view to exploring market possibilities for its Trainer aircraft, the HT—2 which had entered the stage of commercial production.

In November 1955 an HT—2 from Bangalore covered the countries of Burma, Thailand, Cambodia, Singapore and Malaya on a demonstration tour, flying 4,000 miles in 54.8 hours which included 16 hours for demonstration. Wherever it went, the HT—2 created a big impression and HAL is hoping to market in due course, the HT—2 in this far flung territory. Already Singapore is using an HT—2 for its training programme with an Indian Instructor, under the Colombo Plan. Australia too has evinced interest in this aircraft and an HT—2 is now visiting Australia and New Zealand on a demonstration tour.

Last year (1957) Licence negotiations were completed with Folland Aircraft Company for the manufacture by HAL of Britain's latest Light Jet Fighter, the Gnat'. Arrangements were also finalised in collaboration with the Bristol Aero Engine Company for the manufacture of Jet Engines, the first of which will be the 'Orpheus'. A team of British experts arrived in Bangalore and a few HAL engineers were deputed to England to familiarise themselves with the production aspects of the Gnat and the Orpheus. Thus on the foundation stone that was laid 17 years ago, now stands a huge edifice which is bound, as years advance, to add to itself new wings and new columns. To-day HAL has come of age and stands poised at the threshold of a new era in its history—jets and who knows missiles too !

BRANCHES OF THE FACTORY AND THEIR FUNCTIONS

Some idea of the pace of development and the growing sphere of its activities can be gained from the foregoing historical narrative of the factory. It would be seen that her manufacturing projects have tended to grow and her repair and overhaul activities have also been increasing pari passu. Apart from serving as the main overhaul base for internal, Service and Civil aircraft, HAL has all along been also the pivotal point in the East for the repair and overhaul of aircraft from our overseas customers like Ethiopia, Saudi Arabia, Afghanistan, Iran, Ceylon, Burma, Indo-China etc. This branch of her activity is tending to grow rather than diminish.

In order therefore to cope with the mounting demands upon its services, HAL, even as early as 1952, had to initiate a new organisation to lessen its work-load at Bangalore. In that year, a branch of the factory was set up at Barrackpore, near Calcutta, as the first measure of the eventual bifurcation of

the two activities—Manufacture and Overhaul. The choice of Barrackpore was influenced by its proximity to our neighbours in South East Asia. This branch has been functioning mainly as an overhaul base for civillian, internal as well as overseas, and Service Aircraft. For the convenience of overseas operators there is an arrangement whereby overhauled engines can be despatched in advance of receipt of repairable units. The work at Barrackpore has been steadily growing and the time is not far off when the entire work of overhaul will be shifted to Barrackpore.

It may be mentioned in passing that two administrative branches of HAL are functioning, one at Calcutta and the other at Madras, whose main job is customs clearance.

This apart, in view of its close connection with the IAF on the manufacturing and overhauling sides, HAL has been maintaining, since 1948, its own technicians for the servicing and maintenance of service aircraft at the following IAF bases—Poona, Jodhpur, Agra, Barrackpore, Jorhat, Begumpet and Cochin (Naval air Wing).

To forecast that as the industry continues to expand itself its functions will become so variegated as to entail the widest possible dispersal of its activities, is no idle prophesy. In fact a position has been reached in the aircraft industry elsewhere in the world where aircraft factories are fast becoming enclusive units of assembly alone. The practice is to allot to sub-contractors the manufacture of major components including even sheet-metals together with specifications. It is not uncommon in the West today to see that an aircraft manufacturer is not much more than a "technical library" holding patent rights over his designed aircraft, almost the entire work of manufacture being distributed among specialised units. Until such time as these ancillary industries are established in India which can undertake the production of the various components, specialised and proprietary, HAL has perforce to continue as a comprehensive self-contained unit that it is today. But such a diversification has, however, to come about sooner or later.

WORKSHOP SERVICES

Apart from being unique in itself as the only one of its kind anywhere in the East, HAL is also unique in that, unlike anywhere else in the West, it is a comprehensively self-contained unit, performing within its precincts, the functions of repair, overhaul and manufacture. As it has developed, it has equipped itself with all the ancillary workshops necessary, with the most up-to-date facilities and with skilled and highly experienced technicians in charge, for the repair, overhaul, erection and manufacture of aircraft, aero engines etc. Except for a small number of proprietary parts which have either to be purchased locally or imported from abroad, every repair or overhaul or manufacturing project, be it major or minor, is completed within the factory itself by its own workers and technicians with the available tools and raw materials.

Our manufacturing processes (manufacture of aero engines excluded) cover a considerable field and a wide range. Most of our airframe parts are manufactured from imported sheets of Duralumin (U.K.) or Alclad (US) as well as from supplies locally available. We make our own light alloy castings at our foundry for air-frames. From imported plastic sheets we manufacture our own canopies. Landing legs (Oleos) for our trainer aircraft are also made by us. Also we make our own tools and jigs. Jig making is a special art and by making our own tools and jigs we have obviated reliance on imports of such items.

Manufacture is carried out to meet international standards and specifications, and inspection is thorough and rigorous. The Chief Inspector responsible for the final check is an autonomous official responsible only to the General Manager.

There are different shops performing different functions. To list a few, they are, the Machine Shop, Finishing, Wood, Rubber, Plastics, Tool rooms, Radio and Radar and Accessories and Foundry. The Machine shop is in a position to manufacture practically the major portion of components for the repairs of planes, engines etc. The Finishing shop gives the final touches like chromium plating, painting, electro-plating, etc. In the Wood Workshop, complicated wood work required for Vampires and other aircraft is done. The same is the case in regard to Plastics, and as mentioned earlier HAL is probably one of the few factories in the World which manufacture their own plastic items as well as batteries for their own aircraft.

Special mention of the foundry at HAL is called for. In the last few years there has been developed an up-to-date foundry which has been producing all kinds of ferrous and non-ferrous castings for aircraft like Vampire, HT-2 etc., and rail coaches. Not only the castings but also the patterns are made at the foundry. The requisite alloys both of aluminium and magnesium are entirely produced at the foundry. One of the outstanding developments in the foundry of immense potentiality and value is the introduction of the light alloy forgings for which the machinery is now being installed. Expected to be the foremost plant of its kind in this country its contribution to the aircraft industry is bound to be far-reaching. The foundry is making ferrous as well as non-ferrous castings for the production requirements of Hindustan Machine Tools, Bharat Electronics, etc., sister concerns owned by the Government of India. In fact the foundry's contribution to these two concerns is shortly to be stepped up from the present supply of 50,000 lbs. of castings to 80,000 lbs.

The Engine Overhaul section carries out the complete servicing of engines of the Propeller type while the Overhaul and Vampire sections undertake all the various tasks ending with final assembly.

MAINTENANCE SERVICES

In fact no visitor to the factory would fail to be struck by the manifold services rendered by the different workshops and the way they are run by the maintenance services in the factory. Installation, renovation and general day-to-day maintenance of a variety of machinery, mechanical, pneumatic or electrical, as well as checking up for snags and defects and rectifying them are the main functions of these services. These services are helped by the HAL Foundry, the machine, finishing and other shops in getting components made.

On the electrical side, in addition to wiring and installation of electrical services, repairs requiring skill of a very high order such as winding of motors, repairing and servicing of meters are done by the maintenance services. At the same time all the mobile equipment such as cranes, fork lights, mobile generators etc., are completely serviced by the maintenance department.

The transportation section similarly is self-sufficient for all repairs and overhaul.

Before we close this section, it would be of interest to the reader if we state that the current prices of our services compare very favourably with, and are in fact, much cheaper than similar charges abroad. The same is also true of our Trainer aircraft the HT-2 and the Vampire which are far cheaper than the prices of their overseas counterparts.

When it is considered that the engines as well as a few specialised components have to be imported the attractiveness of the Indian prices will be immediately obvious.

FACTORY ADMINISTRATION – SOME ASPECTS

A narrative like this would be incomplete without a brief mention of what part the latest concepts in factory administration play in HAL. It may be pointed out that in the Post Independence era there has been new thinking in India on the question of a re-orientation of the methods of business administration in the context of the rapid industrialisation of what had been, up to now, a predominently agricultural economy. A lead in this sphere has been given by HAL whose management have contributed, in a large measure, to the setting up of the Institute of Industrial Management which is a country-wide organisation in India, and is a forum for the exchange of views and information on how best to run an industrial undertaking.

Another innovation made by HAL in keeping with modern trends is the *mechanisation of its accounting procedure.* In democratic countries where the nationalisation of important industrial concerns is coming to be accepted more and more as a basic principle of policy the question of running them on sound commercial and economic lines has become imperative. It has therefore become very necessary to pre-determine the costs of such undertakings and to ensure that such

INDIAN STEEL WORKERS VISIT UKRAINIAN FACTORIES

Fifty metallurgical engineers from India are receiving training at the iron and steel works in the Ukraine. One of the groups is at the Azovstal Metallurgical Plant, another one is at the Yuzhnogorny concentration plant in Krivoi Rog, and the third at the Zaporozhstal Works in Zaporozhye.

For six months the Indian steel experts are to get first-hand information about the blast furnaces, open hearths, rolling mills, dressing plants, factory railway transport and the system of department administration.

costs are carefully checked and controlled when they go into production. HAL has in operation a sufficiently comprehensive costing and cost-controlling system aided by the latest automatic machines.

TRAINING

As referred to earlier in this article, the Apprentice Training scheme which was inaugurated eight years ago is forging ahead. Particularly in an industry like that of HAL. it has been found advantageous to train its own technicians under various apprentice schemes which are pre-planned and which also include training in various other technical institutions in the country.

The training programme is being stepped up further with the opening very shortly at HAL of a Training School and Hostel for the accommodation of the trainees. The new programme has been so designed as to ensure that there is a steady supply of well trained technicians to meet the needs of future expansion and to make available the right type of technicians who are to be recruited every year.

Also in vogue for about seven years now, the "Training within Industry" programme is also making steady progress. Introduced first under the auspices of the International Labour Organisation, it originally covered the upper level of management percolating gradually thereafter down to the supervisory personnel.

Lastly a word about *welfare amenities*. In common with other modern industrial organisations, these amenities at HAL too, cover housing (not all inclusive as yet) schools, recreation facilities, medical attention, markets etc., etc. But one distinctive feature of the welfare services at HAL which is not found anywhere else is the provision of what is described as the 'Death Relief Fund'. Any employee who dies while in service, as a result of his membership of the fund, is entitled to the benefit of a cash grant of Rs. 1,000/- to his family immediately on his death to help them perform the obsequies etc. This is a boon especially in the case of indigent workers and their destitute families.

HAL'S OUTSTANDING CONTRIBUTION— THE HT-2.

While as a result of historical circumstances, HAL's main contribution has lain in the field of Defence, its chief claim to recognition in the sphere of aircraft production is based on its HT—2, a modern, basic, all-metal trainer aircraft which has made a name for itself among its training compeers elsewhere in the world. HAL, had of course, previously manufactured, under license, the Percival Prentice Trainer, but as already mentioned the HT—2 was the first trainer aircraft designed and developed entirely in India by HAL under the able and eminent direction of Dr. Ghatage. This aircraft is now in service not only with the Indian Air Force and the Indian Naval Air Arm but also with the Civil Aviation Establishments in India as well as Flying Clubs. The Civil Aviation Training Centre at Allahabad, has already purchased 9 HT—2s and is expected to order for more; while the Indian Navy have already acquired initially three HT—2s for their training programme. Lately the Hyderabad Flying Club has acquired an HT—2 for its training programme, the first Flying Club in India to do so. As already pointed out, an HT—2 is now in service with Singapore, under the auspices of the Colombo Plan. Sturdy in construction and aerobatic without restrictions, the HT—2 has proved, in practice, to be one of the best aircraft of its class from the point of view of easy and economical maintenance and operation.

HAL'S CONTRIBUTION TO THE DEVELOPMENT OF CIVIL AVIATION

In yet another sphere, HAL has played a notable role—the development of Civil Aviation in INDIA owes not a little to the considerable assistance given to it by HAL. In fact, it is not too much to claim that Civil Aviation in India owed its early growth largely, if not entirely, to the part played by HAL in providing it with a nucleus of aircraft, overhauled and suitably converted for internal civil air transport.

It will be recalled that with the termination of the war, army Dakotas rendered surplus were acquired by the newly formed internal Civil Airlines in India and all these aircraft which had been in different stages of repair, were completely overhauled and converted into passenger airliners. Every aspect of Dakota conversion was handled by HAL including even the manufacture of seats and fittings as well as the overhaul of engines, propellers, radio instruments etc. The rapid development of Civil aviation in India has thus been largely due to the work that HAL has been able to accomplish.

Although strictly speaking no new aircraft were *manufactured* by HAL in the field of Civil Aviation, (apart, of course, from the HT—2 for training purposes) the work of conversions and/or overhaul of

both planes and engines carried out byHAL, to enable such aircraft to obtain certificates of airworthiness, have been an equally vital or greater contribution to the development of Civil Aviation in India. In addition, special Deluxe conversions of aircraft formerly owned by many Maharajas were carried out by HAL and most of these are now in service with a few private operators in India.

Some idea of the general work of overhaul and conversion during the last 12 years by HAL can be gained from the statistical details given below. The types of Civilian aircraft handled by HAL have been as follows :—

1. Dakota,
2. HT—2,
3. Stinson,
4. Aeronca,
5. Bonanza,
6. Lockheed Hudson,
7. Dove,
8. Beechcraft,
9. Tiger Moth,
10. Chipmunk,
11. Aero 45,
12. Harlow,
13. Noordyne,
14. Grumman Goose,
15. Fairchild Argus.

Of these types it may be stated that Dakotas have accounted for the largest number of overhaul/conversions, say 90% and over, followed way below by Tiger Moths. All the other types of aircraft, put together, did not account for more than an infinitely small percentage.

ENGINE OVERHAUL FOR CIVIL USE

The following types of engines have also been overhauled at HAL for Civil use in the period 1946—58:

1. Pratt & Whitney R. 1830—92
   14 Cylinder Radial Engine,
2. D. H. Gipsy Major,
3. D. H. Gipsy Queen,
4. R. 985
5. Cirrus Major and
6. Continental.

Just as Dakotas have formed the largest single type of planes overhauled by HAL, so also the largest single type of engines overhauled has been the Pratt & Whitney R. 1830—92 which power the Dakotas. Out of a grand total of 2493 of all types of engines overhauled at HAL, the R. 1830—92 alone accounted for 2519 ; Gipsy Queen 302 engines have accounted for 36 and Gipsy Major 30 ; and Gipsy Queen 70, six.

CONVERSION FOR CIVIL USE

In the last 12 years, (1946—58) the total number of conversions carried out by HAL has been quite considerable—62 for internal operators and 17 for foreign customers. As already mentioned, leaving a few other types, the largest number of conversions has been carried out on Dakotas including De-luxe conversions for VIP's.

To restate the position in a nutshell—during the years 1946—58, a total quantity of aircraft of all types overhauled etc. has been 429; conversions 79 (both internal and external) and engines of all types overhauled, 2593.

Detailed figures are as under :—

Statistical table of Major overhaul work carried out by HAL between 1946 & 58.

(1) MAJOR OVERHAUL WORK OF DAKOTA AIRCRAFT AT H. A. L.

Period	Over-hauled.	Re. C. of A.	Check Inspection	Trainer Aircraft Tiger Moth.	Trainer Aircraft HT-2.
1946–47	41	—	—	—	—
47–48	38	29	—	2	—
48–49	14	38	—	13	—
49–50	3	38	—	7	—
50–51	7	37	—	8	—
51–52	1	28	—	—	—
52–53	—	12	—	—	—
53–54	10	11	—	—	—
54–55	—	17	1	—	—
55–56	—	15	5	—	—
56–57	—	13	15	—	—
57–58(9)	—	8	6	—	—
	114	246	27	30	12 **

** The 12 H. T.–2 represent the number of such aircraft built and delivered for Civil use.

(2) ENGINES (CIVIL) OVERHAULED AT HAL

Period	P &W.R. 1830–92	DH Gipsy Major	D.H. G.Q. 70	R. 985	G.Q. 302
1946–47	142	—	—	—	—
47–48	237	—	—	—	—
48–49	260	—	—	—	—
49–50	249	6	—	—	—
50–51	336	8	—	—	—
51–52	392	12	4	—	—
52–53	158	3	2	—	—
53–54	179	—	—	—	—
54–55	163	1	—	—	—
55–56	111	—	—	—	—
56–57	204	—	—	—	21
57–58(9)	88	—	—	2	15
	2519	30	6	2	36

(3) NO. OF CONVERSIONS CARRIED OUT BY HAL FOR CIVIL USE

Internal 62 (1946–1958) Foreign . 17.

RESEARCH AND DEVELOPMENT

The root of all technological growth is Research which is the very-life-blood of industry. And especially, no aircraft industry can survive which does not pay special attention to research and development. Although the aircraft of to-day is a highly variegated and inevitably complicated mechanism, the main stages of its production are fundamentally three: Design, Development and Testing. Keeping this objective very much in the forefront as has already been mentioned, HAL had, as early as 1947, set up a full fledged Engineering and Design Department with Dr. Ghatage as Chief Designer. The Design and Development wing has on its staff a seasoned hand of highly qualified engineers and experts many of whom have had the benefit of training in foreign countries and whose efforts have already contributed not a little to the rapid development in the field of designing. As one example, the HT—2 has been the product of continuous research and development over the past several years.

Recently, placing an even greater emphasis on the importance of designing, HAL has engaged a team of aeronautical experts from abroad under the leadership of an eminent German aircraft designer, Dr. Kurt Tank, as part of its plans for the strengthening and expansion of the design and development organisation in the Factory.

On the side of research, HAL has the advantage of being able to work in close collaboration with the Aeronautical Engineering Department of the Indian Institute of Science which is also located at Bangalore. This has enabled constant interchange of ideas and data between the two organisations to their mutual advantage, particularly in regard to research and development in the field of Aerodynamics and Airplane Structure. For instance, there has been close collaboration between the two organisations in carrying out the wind tunnel tests on the design of HAL's model, HT—2. The provision of another large tunnel, spinning and high speed tunnels and a structures Laboratory at the Institute of Science are bound to be of even greater benefit to HAL.

HAL is also collaborating similarly with several other important development and research institutions all over the country.

In this context, it would be useful to make a special reference to the notable contribution made by the Foundry at HAL to aircraft production. For example mention should be made of the introduction of the DTD 300—11% Mg-Aluminium Alloy casting for the first time at HAL. The production of this Alloy and the casting technique required in order to obtain castings of class one category, have been quite a problem even for those who have been concerned in the production of such castings, over a considerable period. Even to-day a good deal of research and experimentation is being extensively carried out in the U. K. and other foreign countries in this regard. But, in spite of all its limitations, the HAL foundry has been successful in producing this alloy as well as castings in this Alloy. The Foundry also has produced not only Vampire castings but also the patterns required for the production of Vampire castings besides the patterns and castings for HT—2 and other miscellaneous aircraft.

HAL has in addition its own fully equipped Test Laboratory. It controls the entire sphere of activity—from purchase to production. Testing of raw materials to purchase specifications, control of the processes employed for the manufacture and testing of the final product to service standard—all these comprise the day to day functions of the Laboratory. The Laboratory is also useful in finding out ways and

means to anticipate and prevent operational troubles, to improve the manufacturing processes and techniques and to develop new uses for existing materials, products and services.

In this way the Laboratory analyses all processes and lays down specifications, while standards are set for all techniques. It works in co-ordination with the Manufacturing shops.

Work for the Laboratory flows in from almost all departments of the factory. The Finishing and Quality Control Departments call for process checks, while metallographic and X-ray examination of parts from the Foundry, Sheet Metal, Heat Treat and Engines are a regular feature. The testing of raw materials is another vital function undertaken by the Laboratory.

The Factory has in addition, its own experienced Test Pilots and its own airport and Sea Plane landing base.

Having described the Research, Development and testing aspects of aircraft manufacture at HAL, it would not be out of place to any a word about the production set-up. Each manufacturing project is fully preplanned from all the production aspects such as process planning, material planning, time control and so on. This, therefore, makes it possible for the factory to embark on any new project on a pre-determined basis as is the case elsewhere in industrially advanced countries for the manufacture of equipment under modern production line methods.

FUTURE PRODUCTION PLANS

From now on, the main emphasis at HAL will be on MANUFACTURE—writ large. The function of repair/overhaul is to be eventually concentrated at Barrackpore. In fact with the growing stress on manufacture, a position is visualised when in due course the work of overhaul/repair may be distributed among sub-contractors as suitable ancillary industries spring up.

The latest production picture is, that apart from the HT—2 which has been under commercial production for some time now, D. H. Vampire Jet Fighters as well as Trainers are rolling out of the Factory's production line for the IAF.

As for the future, keeping in step with the latest developments in the field of aviation production, HAL will shortly be launching upon a new lines of manufacture—more up-to-date jet fighters. As already referred to plans have been finalised for the production under licence, of Folland's modern light jet fighter, the 'Gnat' and its power plant, the Bristol Orpheus Jet Engine. The factory buildings for these two projects are fast nearing completion. Preliminary work is already under way and production plans are being co-ordinated with the team of Bristol experts now on deputation to the Factory, and according to present expectations, the first Indian built 'Gnat' and the Orpheus Engine will be available within the second five year plan period itself, that is by about 1961.

At the same time plans having already been finalised, work is progressing steadily on the development of an advanced Jet Trainer, a modern medium transport aircraft etc.

But simultaneously with its programme of manufacture there is no doubt that HAL will continue to function, in the future, as in the past, as the main repair and overhaul organisation of aircraft—Military and Civil—Indian and overseas—in this part of the world.

CONCLUSION

In the short span of seventeen years, from being a repair, overhaul and assembly depot, HAL has grown into an important unit of manufacture, unique of its kind anywhere between Cairo and Tokyo, to meet not only the Defence and Civilian requirements of India but also to market some of its products overseas and make its specialised services available to overseas customers. It has, over the past several years, acquired a reputation and set up a tradition which have assured for it a high place among the aircraft industries of the world.

For HAL, the future is full of promise and opportunity. As its manufacturing activities expand and new projects succeed another, it is to be hoped that it will be enabled to take its due place and play its part in world commerce—commercial aircraft production.

Fifteen years later, the clock is coming a full round again to-day with the man-power strength of the factory standing at nearly 12,000; and as the factory expands, the peak figure of 15,000 reached in 1943 bids fair to be eclipsed and even surpassed. The main factory today extends over hundreds of acres of

land and hundreds of new acres are being added to it. New buildings to house new projects are fast springing up and within the next few years, with a huge housing colony accommodating all its thousands of employees within its periphery, Bangalore is destined to become the biggest aviation city anywhere to be found in the East.

In no other field of human endeavour in India has there been such a phenomenal evolution as in the case of our aircraft industry, which in step with the rest of the world, has now entered the era of jet production. So bewilderingly rapid and so sudden are the changes that are overtaking this industry that it seems that even the jet age itself may soon become obsolete, as the age of missiles and rocket propulsion is not far off. So in the coming years, India's Aircraft Industry will have all its resources fully stretched and all its energies fully bent upon keeping abreast of the latest developments in the field of aviation. Consequently, it is not too much to say that HAL will be one of the most vital national organisations in India giving full scope for the free play of indigenous initiative and enterprise and destined to play a major role in the future of India.

RAILCOACH AND BUS BODY MANUFACTURE AT HAL

In yet another important sphere of national production, namely, surface transport, HAL has been making a very sizable contribution—the manufacture of all metal Railway Coaches for the Indian Railways —a revolutionary development unknown before in India. HAL's decision to embark on this new subsidiary project was approved by the British Technical Aircraft mission in 1946 along with its recommendation that HAL should be developed into a centre for future aircraft production in India.

By and large, in the west, Railway Coach construction preceded aircraft construction whereas HAL starting from aircraft construction took up railcoach manufacture. Thus it was able to apply aircraft design principles to railcoach building. The extent of HAL's contribution to India will be appreciated when it is realized that immediately after World War II the coaching stock of the Railways had dwindled to a parlous state leading to lack of adequate trains, overcrowding etc. By its newly designed railcoach perfected in consultation with the Railway Board, HAL has ushered in a renovation in Third Class Travel on Indian Railways and travel by these coaches is comfortable to the point, one may say, of luxury.

As many as one thousand coaches and over have so far been produced by HAL and are operating with the Railways. The present production capacity of the factory is 18 coaches per month which is to be stepped up to one each per day.

The Production of military coaches is also under way.

The next project under HAL's programme of expansion is the manufacture of broad gauge integral coaches in collaboration with M. A. N., a leading railcoach manufacturing firm in Germany. It is expected that within the next five years, HAL would be turning out 300 coaches per annum. The first integral coaches are expected to roll out of the production line at the rate of five coaches from October, 1958.

It may be mentioned that HAL has been a pioneer in this sphere of transport as well as in aircraft construction. The Integral Coach Factory at Perambur which has only recently come into the picture is producing coaches according to a Swiss design.

Linked-up with railcoach manufacture, HAL has been producing pre-fabricated all metal bus body-kits for the various major Road Transport Organisations in India. HAL was until recently producing buses, single and double deckers, out of these pre-fabricated kits but has now given over this line to other firms under Licence Agreements in order to accommodate its other future development plans.

7,000 TRAINS RUN DAILY IN INDIA

About 7,000 passenger and goods trains run daily in India, traversing distances aggregating an average of 562,000 miles per day—or equivalent to more than 400 rail journeys between Delhi and Madras. The trains worked "harder" during 1956-57 (the latest year for which figures are available) than in any previous year in their history. Passenger trains alone "did" 325,000 miles daily, goods trains putting in another 237,000 miles daily. Together, they covered the equivalent of 25 journeys round the globe at equator, every single day, all through the year.

Research Brings Many Improvements To U. S. Railroads

RESEARCH conducted by railroads of the United States has resulted in a steady flow of technical improvements. These improvements have produced railroads vastly superior to those of half a century ago, and intensified research is bringing about still further advances.

So wide in scope is railroad research that it is almost impossible to define its limits. Just as the railroads draw upon practically every section of American industry for their materials and supplies, so do they also cooperate with many industries in carrying out technological development.

A striking example of inter-industry cooperation on railroad research is the development of the diesel-electric locomotive. This relatively new type of locomotive, which is now replacing steam locomotives, is saving U. S. railroads million of dollars annually in operating costs.

The metals industry, by creating strong light-weight alloys, made it possible to build an engine of adequate power within a locomotive size limited by roadway clearances. The automobile industry, using advanced designing, developed the modern diesel engine used in the locomotive. The electrical industry perfected the electric generating the motor-drive equipment. The combination of these and other developments, through cooperation between the railroads and other American industries, eventually resulted in the production of today's efficient diesel-electric locomotives.

What is being done currently in railroad research? With hundreds of specific projects being carried on, any brief answer must of necessity cover only a few significant developments. Following are some of the high points:

Rails—Since breakage of rails had been definitely controlled through improved metallurgy, the "controlled cooling" process for eliminating shatter cracks and the development of detector cars for track inspection, research engineers are now turning their attention to one of the most troublesome parts of track structure—rail joints. New joint bar designs have recently been developed and are being tested. Lubricants to reduce corrosion between the joint bar and the rail are being investigated. Welding processes for building up battered rail ends have been developed.

But more important, perhaps, is a study under way to cut the number of rail joints in half, with a consequent large saving in trouble and maintenance costs, by doubling the present standard length of rails from 39 to 78 feet.

Locomotives—While improvement work on diesel-electric locomotives continues steadily, four new types of locomotive power are occupying the attention of research engineers. These are the oil-fired gas turbine, the coal-fired gas turbine, the steam turbine, and the Ignitron electric locomotive.

The oil-fired gas turbine is relatively new, and ten of them are now being tested under service conditions. The coal-fired gas turbine is a long-range research project. A pilot model of such a turbine has been developed and is now being operated in a test plant, burning pulverised coal and delivering the hot gas steam directly into the turbine rotor. The primary problem in this project is that of removing the larger size particles of flying ashes and burning all the fuel particles in the combustion chamber before the gas stream enters the turbine.

The steam turbine, already in use on railroads on a trial basis, is being further developed by a number of co-operating companies. With steam turbine and electric drive, it marks an abrupt departure from the conventional steam locomotive.

Devices installed in Ignitron electric locomotives make possible the large-scale conversion of alternating current to direct current without any mechanically moving parts or heavy loss of energy. Large mercury-arc rectifier tubes make this possible. Since alternating current is best for motor-drive equipment, this type of locomotive is expected to fill the need for an efficient electric current converter.

Cars—Current research on passenger cars is directed chiefly toward developing improved control of temperature and humidity in air-conditioned cars. In connection with freight cars, many separate research projects are under way to improve those parts which are now subjected to greater stresses due to present-day higher speeds and heavier loads.

A large number of investigations are going on to develop better refrigeration for perishable goods such as fresh fruits and vegetables. More efficient mechanical refrigeration equipment is being developed and, at the same time, conventional icing methods are being greatly improved. New methods are being used to circulate air within cars. New and more effective non-inflammable insulation and heat and sun reflecting paints for car exteriors are being tested.

Signalling and Communications—In the field of signalling, such recent developments as centralised traffic control, automatic train control, cab signals and automatic block signals have contributed immensely toward increasing railroad operating efficiency, safety and economy. They are being steadily improved.

The same is true of communications. Radio is becoming an important part of operations and the number of radios in use on trains, in yards and terminals, and at wayside stations is steadily increasing, totalling almost 10,000 at present as compared with only 4,100 two years ago.

With so many research projects under way in so many fields, it is obvious that the cumulative total of railroad improvement and development work is very extensive. And each change begets others, requiring still further study and investigation. The American railroads, in short, are engaging in research as never before, for as technology progresses, more and more research is required.

NO VICTIMISATION OF RAIL EMPLOYEES—MINISTER REFUTES CHARGES IN RAJYA SABHA

The Railway Minister, Shri Jagjivan Ram, strongly repudiated charges of victimisation by the Railway Board of its employees for political and trade union activities.

Shri Jagjivan Ram, who was replying to the debate on the Appropriation Bill in the Rajya Sabha, said, "We do not victimise employees for political activity. We punish them for political activity."

The Railway Minister said that any citizen who chose to join Government service "should know, and knows", that his citizenship right was abridged to a certain extent—that, whatever be his political belief, he should not take part in political activity.

During the debate Shri Jagjivan Ram referred to the plea for participation of labour in the management of railways, and said that the he was pursuing the proposal to set up joint committees at all levels.

The Railway Minister scouted suggestions for the creation of zones on linguistic and State basis and said that such a step would create an impossible situation.

Shri Jagjivan Ram was also emphatic in rejecting a plea for Statewise representation on the Railway Service Commissions.

The Railway Minister once again pleaded that he would not be able to completely eliminate overcrowding during the Second Plan period. The position, he, however, assured would improve. The Railway were paying more attention to sections and areas where there was chronic overcrowding.

About track renewals, he said, within the available resources, the Railways would take up such renewals as were possible so that the speed of the trains was maintained.

The Railway Minister assured that the Railway Board was trying its best to see that the vacancies reserved for Scheduled Castes and Scheduled Tribes were filled up by the candidates belonging to those communities.

* * *

DIESEL ENGINES FOR RAILWAYS—TENDERS CALLED

The Railways Minister, Shri Jagjivan Ram, said in the Lok Sabha that the Government had invited tenders from various countries for purchase of diesel locomotive engines and also for manufacture of diesel locomotives in India in collaboration with private firms of the Government.

Shri Jagjivan Ram, who was answering supplementaries, said that after the quotations were received the Government would decide whether the manufacture of diesel engines should be in the private or the public sector.

Earlier, Shri Shah Nawaz Khan, Deputy Minister, told Shri G. P. Sinha that the Government had placed orders for 100 locomotives. The Tata Locomotive Works were not manufacturing diesel locomotive engines at present.